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*ESI for*

# Dye Contaminated Waste Water Treatment through Metal-Organic Frameworks (MOFs) based Materials

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**Contents:**

**Table S1.** Comparison of important survey papers related to the MOF-based various water treatment techniques.

| Sr. No. | Adsorbents | Research group | Main Focus | Main contribution | Ref |
|---|---|---|---|---|---|
| 1 | Ferric-MOFs | Johari *et al.* | Dye removal using Fe based MOFs | A comprehensive review of the MIL-100(Fe), used for removing different types of dyes in wastewater treatment. | 1 |
| 2 | MOFs | Lee *et al.* | Adsorptive removal of dyes | A thorough survey of different MOFs utilized in dye removal, especially, focusing on the factors affecting the adsorption process. | 2 |
| 3 | MOFs based membrane | Yoon *et al.* | Water purification | MOF-based FO/RO/NF/UF membrane filtration used in water purification, a brief survey of their utilisation in dye removal. | 3 |
| 4 | MOFs | Ayati *et al.* | Removal of azo dyes from wastewater | Primarily focusing on the azo dye infected water treatment via different MOFs along with a general overview of the effectiveness of various MOFs adsorbents under different physiochemical processes. | 4 |
| 5 | MOFs | Jhung *et al.* | Removal of hazardous material | A review on the separation of various hazardous compounds using different MOFs, includes dye removal. | 5 |
| 6 | MOF based membranes | Hu *et al.* | Water treatment | A survey on MOF-containing membranes in the potential environmental application, especially focusing on the removal of heavy metal ions, micropollutants, dyes, and seawater desalination. | 6 |
| 7 | MOFs based polymer mix matrix membrane | Nady *et al.* | Water purification | A full review on the different recently introduced MOFs-MMMs materials in water purification applications. A brief discussion of their application in dye removal. | 7 |
| 8 | MOFs | Bello *et al.* | Dye adsorption | A detailed review of the selected MOFs used for the Laboratory, industrial, environmental, and dye adsorbents. | 8 |

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| 9 | Magnetic Nanoparticles@MOFs material | Zhu *et al.* | Sustainable Environment Adsorbents | An in-depth review on the removal of hazardous contaminants (organic pollutants, heavy metal ions, and dye) from the environment. | 9 |
| 10 | MOFs | Jhung *et al.* | Removal of hazardous material: possible adsorption Mechanism | MOFs-based adsorptive removal of hazardous material reviewed (includes dye) and also discuss interactions or mechanisms of dye adsorption. | 10 |
| 11 | Water stable MOFs | Duu-jong *at el.* | As adsorbents in aqueous solution | A mini-review on the efforts to develop water-stable MOFs as efficient adsorbents in aqueous solutions. | 11 |
| 12 | MOFs | Armentano *et al.* | Water remediation | A comprehensive survey,<br><br>critically highlighting the latest developments achieved in the adsorptive removal of hazardous material (metal cations, inorganic acids, oxyanions, nuclear wastes, organic – pharmaceuticals and personal care products, artificial sweeteners, and feed additives, agricultural products, organic dyes, and industrial products). | 12 |
| 13 | Graphene oxide and MOFs composite | Huang *et al.* | Synthesis and application | A detailed review on the synthesis and applications of GO/MOF composites, especially focusing on the adsorption of various organic pollutants (includes dye). | 13 |
| 14 | MOFs | Zhou *et al.* | Removal of organic pollutants | A review on recent literature of the effectiveness of MOFs for the adsorption of selected organic pollutants (dyes, antibiotics and pesticides) from aqueous solution. | 14 |
| 15 | Magnetic MOFs (MMOFs) | Zeng *et al.* | Environmental monitoring and remediation | A detailed survey on the synthesis and classification of magnetic MOF composites, focusing on then their physicochemical properties and remediation of environmental contaminants (includes dye). | 15 |

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| 16 | MOFs | Kai-lv *et al.* | Removal of common aromatic pollutants | A comprehensive survey, especially related to the removal and preconcentration of aromatic pollutants (organic pollutants, pharmaceutical by-products, and dyes) using MOFs are provided in wastewater treatment. | 16 |
| 17 | MOFs/carbon based material | Feng *et al.* | Environmental remediation | A mini-review on recent advances of MOFs-Carbon based composites in environmental remediation. | 17 |
| 19 | MOFs | Rizwan *et al.* | Removal of environmental contaminations | A review article on the application of MOFs toward how to remove the toxic agents (organic, inorganic, dye and heavy metal pollutant) from water. | 18 |
| 21 | MOFs | Khan *et al.* | Dye removal mechanism | An in-depth review on the removal of the dye from wastewater using different MOFs, focuses on adsorption mechanisms or interactions | 19 |
| 22 | MOFs | Horcajada *et al.* | Removal of organic contaminations | A review article on the elimination of anthropogenic pollutant (Pharmaceuticals and Personal Care Products, Herbicides and Pesticides, and organic dyes) from waste water using MOFs. | 20 |
| 23 | Al-MOFs | Samokhvalov *et al.* | Sorption in solutions | A review Article provides an analysis of the published reports on adsorption of various organic and inorganic compounds (including dye) on microporous and mesoporous Al-MOFs in the liquid phase. | 21 |
| 25 | MOFs + MOF gels+ magnetic MOFs | Kurkuri *et al.* | Water remediation and separation of oils from water | A detailed review article on the MOF-based material like aerogels/hydrogels, MOF-derived carbons (MDCs), hydrophobic MOFs, and magnetic framework composites (MFCs) to remediate water from contaminants (includes dye) and for the separation of oils from water. | 22 |
| 26 | MOFs | Suresh *et al.* | Adsorptive dye removal | A review article on the adsorptive removal of hazardous dye molecules from wastewater utilizing MOFs. | 23 |
| 27 | MOFs | Man-Au *et al.* | Dye removal | A mini review on the removal of the dye moieties from waste water by MOFs. | 24 |

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| 28 | MOFs+ Magnetic MOFs + MOF based membrane + MOF based gels | | Dye removal using MOF based technologies | An extensive survey on MOF-based technologies includes magnetic MOFs, MOF-based membranes, and hydrogel/aerogels, which are used in the removal of hazardous cationic and anionic dyes from dye wastewater. | Current review article |

**Table S2.** Advantages and disadvantages of different dye removal methods.[25-47]

| Methods | | Advantages | Disadvantages |
|---|---|---|---|
| **Biological** | Adsorption by microbial biomass, both alive and dead | Several microbial species have a strong affinity for certain colors. Good option with a low cost. | The majority of hazardous dyes are incompatible. |
| | Dye bioremediation by Anaerobic biomass | Decolonization of water-soluble and azo dyes is easy. | Hydrogen sulphide and methane are created during the anaerobic process. |
| | White-rot fungi in dye degradation | To degrade dye, white-rot fungi produce enzymes. | The production of enzymes is not a reliable process. |
| **Chemical** | Photochemical | There will be no sludge produced, and COD will be reduced significantly. | Byproducts are formed and Light penetration limitation. |
| | Sonolysis | Chemical additives are not used, and so no additional sludge is produced. | It needs a large amount of dissolved gas ($O_2$). At this stage of reactor development, it is not economically viable. |
| | Fenton’s reagent | Fenton's reagent is a chemically highly effective treatment method. | Produce sludge. |
| | Electrolysis | Decolonization of soluble and insoluble dyes. No sludge buildup and no chemical consumption. | High flow rates result in a direct reduction in dye removal. The high cost of electricity is a barrier. |
| | Oxidation | Very easy to use. | To start the process, need an oxidizing agent. Disperse dyes are not compatible. This method can be related with secondary contamination. |
| | Sodium hypochlorite (NaOCl) | Enables and enhances azo-bond cleavage. | Further chlorine pollution. This method can be related to secondary contamination. |
| | Wet air oxidation | This well-established method is especially well-suited to effluents that are both too dilute for incineration and too hazardous for incineration. | The use of high pressure and temperature is connected with high cost. |
| | Advanced oxidation Processes (AOPs) | Create a higher number of extremely reactive free radicals that outperform traditional oxidants in terms of decolonization. | Complete oxidation may not be achieved due to unwanted toxic byproducts. The presence of radical scavengers reduces the efficacy of various pH-dependent activities. |
| | Ozonation | Ozone can be used in a gaseous form, and it does not affect the volume of wastewater or sludge. | The half-life is relatively short (20 min) |
| **Physical methods** | Ion exchange | The adsorbent can be renewed without losing its effectiveness, and dye recovery is theoretically achievable. | Dye-specific ion exchange resins are expensive to regenerate. |

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| | Filtration | Most dyes can be removed. | Generates a considerable amount of sludge. Membrane replacement is expensive. |
| | Floatation | High removal efficiency. | The high cost of electricity is a barrier. |
| | Coagulation | Removing dispersion, sulphur, and vat dyes in a cost-effective manner. | Method is pH-dependent; generates a considerable amount of sludge. |
| | Adsorption | Good at removing a wide range of dyes, including azo, reactive, and acid dyes; especially useful at eliminating basic dyes. | Regeneration is costly and results in an adsorbent loss. |
| **Hybrid methods** | Solar/Fenton | Highly effective on orange-II dye. | Produce sludge require sunlight for processing, and very costly. |
| | UV/Fenton | Effective on disperse dyes. | Requires UV radiation on a very large scale and produce sludge |

**Table S3.** Dye adsorption through MOFs and MOF composite materials in last decades.

| MOFs or MOFs composite | Dye name | Adsorption efficiency/Removal capacity | Year | Ref. |
|---|---|---|---|---|
| MIL-53 | MO | 57.9 mg/g | 2010 | 48 |
| MIL-101 | MO | 114 mg/g | | |
| ED-MIL-101 | MO | 160 mg/g | | |
| MOF-235 | MB | 252 mg/g | 2011 | 49 |
| | MO | 501 mg/g | | |
| MIL-101(Cr) | Xylenol orange | 322–326 mg/g | 2012-2014 | 50 |
| ZIF-67 | AB40 | 55 mg/g | | 51 |
| Cu-MOF | CR | 828.50 mg/g | | 52 |
| ZJU-24-0.89 | MB | 902 mg/g | | 53 |
| HKUST-1 | MB | 83.6 to 94.4 mg/g | | 54 |
| $Cu_3(BTC)_2(H_2O)_3$ | MB | 95% | | 55 |
| HKUST-1@ABS | MB | 98.3% | | 56 |
| HKUST-1@$\gamma$-$Fe_2O_3$/C | MB | 370.2 mg/g | | 57 |
| MIL-101(Cr)@$PW_{11}V$ | MB | 98% | | 58 |
| | RhB | 60 % | | |
| | MO | 19% | | |
| MIL-101(Al)-$NH_2$ | MB | 762 mg/g | | 59 |
| $H_6P_2W_{18}O_{62}$@$Cu_3(BTC)_2$ | MB | 298.34 mg/g | 2015 | 60 |
| MIL-100(Fe) | MB | 1105 mg/g | | 61 |
| MIL-125(Ti) | RhB | 59.92 mg/g | | 62 |
| UiO-66 | MB | 90.59 % | | 63 |
| | RhB | 77.47 % | | |
| | Neutral red | 74.84 % | | |
| | MO | 38.24 % | | |
| | Acid chrome blue K | 31.61 % | | |
| UiO-66-$NH_2$ | MB | 97.27 % | | |
| | RhB | 82.69 % | | |
| | Neutral red | 75.85 % | | |
| | MO | 28.80 % | | |
| | Acid chrome blue | 22.53 % | | |

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| | K | | | |
| $Fe_3O_4$@MIL-100(Fe) | Methyl red | 625 mg/g | | 64 |
| MIL-53(Al)–$NH_2$ | MG | 38.09 mg/g | | 65 |
| | MB | 45.97 mg/g | | |
| HKUST-1@$Fe_3O_4$ | MB | 245 mg/g | | 66 |
| MIL-68(In) | CR | 1204 mg/g | | 67 |
| TMU-1 | MB | 100 % | | 68 |
| | MO | | | |
| ZIF-8 | CR | 1250 mg/g | | 69 |
| $Fe_3O_4$@MIL-100(Fe) | MB | 73.8 mg/g | | 70 |
| | RhB | 28.36 mg/g | | |
| MIL-68(Al) | MB | 1666.67 mg/g | | 71 |
| | RhB | 1111.11 mg/g | | |
| $H_6P_2W_{18}O_{62}$/MOF-5 | MB | 97 % | | 72 |
| | MO | 10% | | |
| | RhB | 10% | | |
| MIL-68(In)–NH2 | RhB | 50 % | | 73 |
| In-MOF@GO | RhB | 267 mg/g | | 73 |
| $Fe_3O_4$/MIL-101 | MO | 90 % | | 74 |
| | Xylenol orange | | | |
| | Fluorescein sodium | | | |
| $Fe_3O_4$/MIL-101(Cr) | Acid red 1 | 97.9 % | | 75 |
| | Orange G | 97.7 % | | |
| FJI-C2 | MB | 1323 mg/g | | 76 |
| HKUST-1@GO@$Fe_3O_4$ | MB | 1604 mg/g | | 77 |
| MIL-101(Al)-$NH_2$ | ICM | 135 mg/g | | 78 |
| | MG | 274.4 mg/g | | |
| MIL-101(Fe)@$H_3PW_{12}O_{40}$ | MB | 473.7 mg/g | | 79 |
| | RhB | 96 % | | |
| ZJU-71 | MB | 9.52 mg/g | | 73 |
| MIL-101(Cr)@GO | AM | 111.01 mg/g | | 80 |
| | CM | 77.61 mg/g | | |
| | SY | 81.36 mg/g | | |
| HLJU-2 | CV | 44.55 mg/g | | 81 |
| | RhB | 4789 mg/g | | |

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|---|---|---|---|---|
| UiO-66 | Safranin T | 97 % | | 78 |
| Ni-MOFs | CR | 2046 mg/g | 2017 | 82 |
| TMU-7 (Cd) | CR | 97 mg/g | | 83 |
| $Fe_3O_4$@MIL-100(Fe) | MB | 221 mg/g | | 84 |
| | RhB | 93.5 % | | |
| UiO-66-P | MB | 91.1 mg/g | | 85 |
| Uio-66 | MB | 24.5 mg/g | | 86 |
| | Acid Chrome Blue K | 228.6 mg/g | | |
| | MO | 172.5 mg/g | | |
| | CR | 493.1 mg/g | | |
| MIL-53(Fe)/PAN | MB | 70 % | | 87 |
| HKUST-1@ $Fe_3O_4$-1 | MB | 118 mg/g | | 88 |
| HKUST-1@UiO-66 | MB | 526 mg/g | | 89 |
| LIFM-WZ-3 | CV | 713.5 mg/g | | 90 |
| In-MOF | MB | 724.64 mg/g | | 91 |
| JLU-Liu39 | MB | 308 mg/g | | 92 |
| | RhB | 16 mg/g | | |
| PCN-222(Zr) | MB | 1239 mg/g | | 93 |
| | MO | 1022 mg/g | | |
| ZIF-8@GO | MG | 3300 mg/g | | 94 |
| HPU-5 | RhB | 01415 mg/g | | 95 |
| | MO | 0.185 mg/g | | |
| HPU-6 | RhB | 0.34 mg/g | | |
| | MO | 0.42 mg/g | | |
| PCN-124-Cu | CBB | 78.7 mg/g | | 96 |
| *N*-doped $TiO_2$ nanoparticles caged in MIL-100 (Fe) | MB | 99.1 % | | 91 |
| | RhB | 93.5 % | | |
| Co-MOFs | CR | 4885.20 mg/g | 2018 | 97 |
| UiO-66 | MB | 69.8 mg/g | | 98 |
| | MO | 83.7 mg/g | | |
| Zn-MOF | MB | 326 mg/g | | 99 |
| | RhB | 3.75 mg/g | | |
| | CV | 90.77 % | | |
| $Fe_3O_4$@$SiO_2$@UiO-66- $NH_2$ | MB | 128 mg/g | | 100 |

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|---|---|---|---|---|
| | MO | 130 mg/g | | |
| $MgFe_2O_4$@MOF | RhB | 219.78 mg/g | | 101 |
| | RhBG | 306.75 mg/g | | |
| MOF-199 | B41 | 1257 mg/g | | 102 |
| POM@UiO-66 | RhB | 222.6 mg/g | | 103 |
| | MG | 190.6 mg/g | | |
| | Orange G | 40 mg/g | | |
| MOF-5@$Ag_2O$ | AO | 260.70 mg/g | | 104 |
| Fe-MOFs | CR | 90.67 % | | 105 |
| | RhB | 70.90 % | | |
| | Orange II | 88.21 % | | |
| $Fe_3O_4$@MIL-100 (Fe) | AO10 | 100 % | | 106 |
| $NH_2$-MIL-88B (Fe) | MB | 100 % | | 107 |
| MIL-125(Ti)-NH2 | B46 | 1257 mg/g | | 102 |
| | MB | 862 mg/g | | |
| Cd-MOF | CV | 221 mg/g | | 108 |
| Zn-MOF | CV | 7.355 mg/g | | 99 |
| | RhB | 2.977 mg/g | | |
| | MB | 6.394 mg/g | | |
| LIFM-WZ-3 | MB | 983 mg/g | | 108 |
| MIL-53(Al)-$NH_2$@$Fe_3O_4$@CA, CA: citric acid | MB | 325.62 mg/g | | 109 |
| | MG | 329.61 mg/g | | |
| MIL-100(Fe) | MB | 96 % | | 105 |
| | RhB | 99% | | |
| | CBB | 100% | | |
| MIL-100 (Al) | MB | 97% | | |
| | RhB | 34 % | | |
| | CBB | 100 % | | |
| MIL-101(Cr)-$NH_2$@$Fe_3O_4$ | MB | 370.3 mg/g | | 107 |
| MIL-101(Cr)@$P_2W_{18}O_{62}$@$Fe_3O_4$ | MB | 200 mg/g | | 110 |
| | RhB | 164 mg/g | | |
| | MO | 60% | | |
| UiO-66@Ce | MB | 145.3 mg/g | | 111 |
| | ACK | 245.8 mg/g | | |
| | MO | 639.6 mg/g | | |

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| ESF@ZIF-8 | MG | 127.1 mg/g | | 112 |
| | RhB | 19 mg/g | | |
| ESF@ZIF-67 | MG | 840.2 mg/g | | |
| MIL-125-$NH_2$@$Fe_3O_4$ | MG | 457 mg/g | | 113 |
| UiO-66-0.75-$(COOH)_2$ | RhB | 94 mg/g | | 111 |
| Al-SA MOF | Acid Black 1 | 199.1 mg/g | | 114 |
| UiO-66 | ARS | 400 mg/g | | 115 |
| IPM-MOF-201 | ARS | 50% | | 116 |
| | MO | 50% | | |
| UiO-66@CNT, CNT: carbon nanotubes7 | AY17 | 89.39 mg/g | | 117 |
| | AO7 | 80.63 mg/g | | |
| MIL-100(Fe)@GO | MB | 1231 mg/g | | 118 |
| | MO | 1189 mg/g | | |
| Cd-MOF | MO | 93% | | 119 |
| Zn-MOF | MO | 100% | | |
| Ni-MOF | CR | 276.7 mg/g | 2019 | 120 |
| Zn/Co ZIF | MB | 92% | | 121 |
| BUT-29 | MB | 1119 mg/g | | 122 |
| SCNU-Zl-Cl | MO | 285 mg/g | | 123 |
| | Acid orange A | 180 mg/g | | |
| | CR | 585 mg/g | | |
| | MB | 262 mg/g | | |
| Cd-ZIF | MG | 395.87 mg/g | | 124 |
| CoOF | Acid red 18 | 44.26 mg/g | | 125 |
| UiO-66 | Acid blue 92 | 73 % | | 126 |
| | Direct red 2B | 76 % | | |
| | Maxilon blue M2G | 46.6 % | | |
| BUT-29 | CV | 832 mg/g | | 122 |
| MOF-235 | CR | 1250 mg/g | | 127 |
| | Lemon yellow | 250 mg/g | | |
| Mn-MOF | CV | 938 mg/g | | 128 |
| ZIF-67 | Acid orange 7 | 738 mg/g | | 129 |
| | CR | 3899.8 mg/g | | 130 |
| NENU@0.03GO | B46 | 243 mg/g | | 131 |
| PCN-222(Fe) | BG | 854 mg/g | | 132 |

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|---|---|---|---|---|
| | CV | 812 mg/g | | |
| | AB80 | 85% | | |
| | AR | 417 mg/g | | |
| MIL-68(Al)@PVDF, PVDF: polyvinylidene fluoride | MB | 74.35 μg $cm^{-2}$ | | 133 |
| MIL-140X, (X = F, −2COOH, $-2NO_2$) | MB | 100% | | 134 |
| MIL-140X, (X = B, −2COOH, $-2NO_2$, C, E, F, $-SO_3H$) | NB | 100 % | | |
| SCNU-Z1-Cl | MB | 262 mg/g | | 135 |
| | RhB | 130 mg/g | | |
| | AO7 | 180 mg/g | | |
| | MO | 285 mg/g | | |
| MIL-101(Fe)@dopa@Fe3O4 | MG | 833.33 mg/g | | 136 |
| UiO-66@wood | RhB | 690 mg/g | | 137 |
| MIL-101(Cr) | AB92 | 185 mg/g | | 138 |
| | Red 80 | 227 mg/g | | |
| MIL-88A(Fe)@$Fe_3O_4$ | BPB | 141.5 mg/g | | 139 |
| UiO-66-$NH_2$@Tb-CP | CBB | 397.3 mg/g | | 140 |
| Fe-BDC | MB | 94.74% | | 141 |
| TFMOF(Zr) | CR | 252.25 mg/g | 2020 | 142 |
| Ce(III)-doped UiO-67 | CR | 799.6 mg/g | | 143 |
| | MB | 398.9 mg/g | | |
| | MO | 401.2 gm/g | | |
| ln-TATAB | CR | 299 mg/g | | 144 |
| | Acid chrome blue K | 343 mg/g | | |
| | Acid red 26 | 259 mg/g | | |
| | Direct black 38 | 242 mg/g | | |
| | Orange II | 217 mg/g | | |
| UiO-66/PGP | CR | 99.6 % | | 145 |
| | MB | 100 % | | |
| | MO | 94.8 % | | |
| | RhB | 95.5 % | | |
| Printed MOF/CA-GE | MB | 99.8 % | | 143 |
| GO-Cu-MOF | MB | 262 mg/g | | 146 |
| CuBDC | MB | 41.01 mg/g | | 123 |

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|---|---|---|---|---|
| MOF-NiZn | MB | 398.9 mg/g | | 147 |
| ABim-Zn-MOF | MB | 174.64 mg/g | | 148 |
| | Chicago sky blue | 144.26 mg/g | | |
| ZIF-8 | MG | 1000 mg/g | | 149 |
| AC@MIL-101(Cr) | Direct Red 31 | 99.4 % | | 150 |
| | Acid Blue 92 | 92.9 % | | |
| MOF-2(Cd) | MB | 99.90 % | | 151 |
| $[Ni_2F_2(4,4' bipy)_2(H_2O)_2](VO_3)_2{\cdot}8H_2O$ | CR | 242.1 mg/g | | 152 |
| MOF-5/COF ($M_5C$) | AO | 17.95 mg/g | | 153 |
| | RhB | 16.18 mg/g | | |
| PFC-24-Zr | MO | 12 mg/g | | 154 |
| HKUST ($Cu_3(BTC)_2$) | MB | 833.33 mg/g | | 155 |
| $[\{Cu(bipy)_{1.5}(H_2\text{- }pdm)\}{\cdot}2NO_3{\cdot}H_2O]_n$ (Cu-MOF-1) | MB | 98.23 % | | 156 |
| MOF-5@GO | RhB | 151.62 mg/g | | 157 |
| PCN-224 | MB | 1015.7 mg/g | | 158 |
| MIP-202 Zr-MOF | MB | 36.071 mg/g | 2021 | 159 |
| | Direct red 81 | 19.012 mg/g | | |
| $\{[Ag(3\text{-}(4H\text{-}1,2,4\text{-triazol-}4\text{-yl})\text{-}5\text{-}(trifluoromethyl)pyridine)](BF_4)\}_n$ | MB | 409 | | 160 |
| | CR | 264 | | |

## References


1. N. A. Johari, N. Yusof, A. F. Ismail, F. Aziz, W. N. W. Salleh, J. Jaafar, N. H. H. Hairon and N. Misdan, *Journal of Advanced Research in Fluid Mechanics Thermal Sciences*, 2020, **75**, 68-80.
2. M. J. Uddin, R. E. Ampiaw and W. Lee, *Chemosphere*, 2021, 131314.
3. B.-M. Jun, Y. A. Al-Hamadani, A. Son, C. M. Park, M. Jang, A. Jang, N. C. Kim and Y. Yoon, *Separation Purification Technology*, 2020, **247**, 116947.
4. A. Ayati, M. N. Shahrak, B. Tanhaei and M. Sillanpää, *Chemosphere*, 2016, **160**, 30-44.
5. N. A. Khan, Z. Hasan and S. H. Jhung, *Journal of hazardous materials*, 2013, **244**, 444-456.
6. S. Yu, H. Pang, S. Huang, H. Tang, S. Wang, M. Qiu, Z. Chen, H. Yang, G. Song and D. Fu, *Science of The Total Environment*, 2021, 149662.
7. A. Elrasheedy, N. Nady, M. Bassyouni and A. El-Shazly, *Membranes*, 2019, **9**, 88.
8. A. A. Adeyemo, I. O. Adeoye and O. S. Bello, *Toxicological Environmental Chemistry*, 2012, **94**, 1846-1863.

9. G. Zhao, N. Qin, A. Pan, X. Wu, C. Peng, F. Ke, M. Iqbal, K. Ramachandraiah and J. Zhu, *Journal of Nanomaterials*, 2019, **2019**.
10. Z. Hasan and S. H. Jhung, *Journal of hazardous materials*, 2015, **283**, 329-339.
11. Y.-J. Lee, Y.-J. Chang, D.-J. Lee and J.-P. Hsu, *Journal of the Taiwan Institute of Chemical Engineers*, 2018, **93**, 176-183.
12. M. Mon, R. Bruno, J. Ferrando-Soria, D. Armentano and E. Pardo, *Journal of materials chemistry A*, 2018, **6**, 4912-4947.
13. H.-j. Qu, L.-j. Huang, Z.-y. Han, Y.-x. Wang, Z.-j. Zhang, Y. Wang, Q.-r. Chang, N. Wei, M. J. Kipper and J.-g. Tang, *Journal of Porous Materials*, 2021, 1-29.
14. A. Tchinsa, M. F. Hossain, T. Wang and Y. Zhou, *Chemosphere*, 2021, 131393.
15. B. E. Meteku, J. Huang, J. Zeng, F. Subhan, F. Feng, Y. Zhang, Z. Qiu, S. Aslam, G. Li and Z. Yan, *Coordination chemistry reviews*, 2020, **413**, 213261.
16. C. Liu, L.-Q. Yu, Y.-T. Zhao and Y.-K. Lv, *Microchimica Acta*, 2018, **185**, 1-12.
17. L. Zhu, L. Meng, J. Shi, J. Li, X. Zhang and M. Feng, *Journal of environmental management*, 2019, **232**, 964-977.
18. T. Rasheed, A. A. Hassan, M. Bilal, T. Hussain and K. Rizwan, *Chemosphere*, 2020, **259**, 127369.
19. M. S. Khan, M. Khalid and M. Shahid, *Materials Advances*, 2020, **1**, 1575-1601.
20. S. Rojas and P. Horcajada, *Chemical reviews*, 2020, **120**, 8378-8415.
21. A. Samokhvalov, *Coordination Chemistry Reviews*, 2018, **374**, 236-253.
22. R. M. Rego, G. Kuriya, M. D. Kurkuri and M. Kigga, *Journal of Hazardous Materials*, 2021, **403**, 123605.
23. B. Parmar, K. K. Bisht, G. Rajput and E. Suresh, *Dalton Transactions*, 2021, **50**, 3083-3108.
24. V. K.-M. Au, *Frontiers in Chemistry*, 2020, **8**.
25. V. Katheresan, J. Kansedo and S. Y. Lau, *Journal of environmental chemical engineering*, 2018, **6**, 4676-4697.
26. T. Robinson, G. McMullan, R. Marchant and P. Nigam, *Bioresource technology*, 2001, **77**, 247-255.
27. K. A. Adegoke and O. S. Bello, *Water Resources Industry*, 2015, **12**, 8-24.
28. Y. Mu, K. Rabaey, R. A. Rozendal, Z. Yuan and J. Keller, *Environmental science technology*, 2009, **43**, 5137-5143.
29. M. A. M. Salleh, D. K. Mahmoud, W. A. W. A. Karim and A. Idris, *Desalination*, 2011, **280**, 1-13.
30. F. I. Hai, K. Yamamoto and K. Fukushi, *Critical Reviews in Environmental Science Technology*, 2007, **37**, 315-377.
31. U. Pagga and K. Taeger, *Water Research*, 1994, **28**, 1051-1057.
32. Y. Fu and T. Viraraghavan, *Bioresource technology*, 2001, **79**, 251-262.
33. A. Maleki, A. H. Mahvi, R. Ebrahimi and Y. Zandsalimi, *Korean Journal of Chemical Engineering*, 2010, **27**, 1805-1810.
34. N. L. Stock, J. Peller, K. Vinodgopal and P. V. Kamat, *Environmental science technology*, 2000, **34**, 1747-1750.
35. E. Guivarch, S. Trevin, C. Lahitte and M. A. Oturan, *Environmental Chemistry Letters*, 2003, **1**, 38-44.
36. Z. Shen, D. Wu, J. Yang, T. Yuan, W. Wang and J. Jia, *Journal of Hazardous Materials*, 2006, **131**, 90-97.
37. M. Basu, A. K. Sinha, M. Pradhan, S. Sarkar, Y. Negishi and T. Pal, *Environmental science technology*, 2010, **44**, 6313-6318.
38. M. Kirihara, T. Okada, Y. Sugiyama, M. Akiyoshi, T. Matsunaga and Y. Kimura, *Organic Process Research Development*, 2017, **21**, 1925-1937.

39. L. Lei, X. Hu, G. Chen, J. F. Porter and P. L. Yue, *Industrial engineering chemistry research*, 2000, **39**, 2896-2901.
40. V. S. Mishra, V. V. Mahajani and J. B. Joshi, *Industrial Engineering Chemistry Research*, 1995, **34**, 2-48.
41. S. Anandan, G.-J. Lee, P.-K. Chen, C. Fan and J. J. Wu, *Industrial engineering chemistry research*, 2010, **49**, 9729-9737.
42. D. Lv, R. Wang, G. Tang, Z. Mou, J. Lei, J. Han, S. De Smedt, R. Xiong and C. Huang, *ACS applied materials interfaces*, 2019, **11**, 12880-12889.
43. S. Singh, V. C. Srivastava and I. D. Mall, *The Journal of Physical Chemistry C*, 2013, **117**, 15229-15240.
44. J. Bandara, C. Morrison, J. Kiwi, C. Pulgarin and P. Peringer, *Journal of Photochemistry Photobiology A: Chemistry*, 1996, **99**, 57-66.
45. F. Torrades, J. Garcıa-Montano, J. A. Garcıa-Hortal, X. Domènech and J. Peral, *Solar Energy*, 2004, **77**, 573-581.
46. Y. Xu, *Chemosphere*, 2001, **43**, 1103-1107.
47. M. Neamtu, A. Yediler, I. Siminiceanu, M. Macoveanu and A. Kettrup, *Dyes pigments*, 2004, **60**, 61-68.
48. E. Haque, J. E. Lee, I. T. Jang, Y. K. Hwang, J.-S. Chang, J. Jegal and S. H. Jhung, *Journal of Hazardous Materials*, 2010, **181**, 535-542.
49. E. Haque, J. W. Jun and S. H. Jhung, *Journal of Hazardous materials*, 2011, **185**, 507-511.
50. C. Chen, M. Zhang, Q. Guan and W. Li, *Chemical Engineering Journal*, 2012, **183**, 60-67.
51. X. Kang, Z. Song, Q. Shi and J. Dong, *Asian Journal of Chemistry*, 2013, **25**, 8324-8328.
52. J. Hu, H. Yu, W. Dai, X. Yan, X. Hu and H. Huang, *RSC advances*, 2014, **4**, 35124-35130.
53. Q. Zhang, J. Yu, J. Cai, R. Song, Y. Cui, Y. Yang, B. Chen and G. Qian, *Chemical communications*, 2014, **50**, 14455-14458.
54. S. Lin, Z. Song, G. Che, A. Ren, P. Li, C. Liu and J. Zhang, *Microporous mesoporous materials*, 2014, **193**, 27-34.
55. L. Li, J. C. Li, Z. Rao, G. W. Song and B. Hu, *Desalination Water Treatment*, 2014, **52**, 7332-7338.
56. Z. Wang, J. Wang, M. Li, K. Sun and C.-j. Liu, *Scientific reports*, 2014, **4**, 1-7.
57. Y. Xiong, F. Ye, C. Zhang, S. Shen, L. Su and S. Zhao, *RSC advances*, 2014.
58. A. X. Yan, S. Yao, Y. G. Li, Z. M. Zhang, Y. Lu, W. L. Chen and E. B. Wang, *Chemistry–A European Journal*, 2014, **20**, 6927-6933.
59. E. Haque, V. Lo, A. I. Minett, A. T. Harris and T. L. Church, *Journal of Materials Chemistry A*, 2014, **2**, 193-203.
60. X. Liu, J. Luo, Y. Zhu, Y. Yang and S. Yang, *Journal of Alloys Compounds*, 2015, **648**, 986-993.
61. F. Tan, M. Liu, K. Li, Y. Wang, J. Wang, X. Guo, G. Zhang and C. Song, *Chemical Engineering Journal*, 2015, **281**, 360-367.
62. H. Guo, F. Lin, J. Chen, F. Li and W. Weng, *Applied Organometallic Chemistry*, 2015, **29**, 12-19.
63. Q. Chen, Q. He, M. Lv, Y. Xu, H. Yang, X. Liu and F. Wei, *Applied Surface Science*, 2015, **327**, 77-85.
64. S. Dadfarnia, A. H. Shabani, S. Moradi and S. Emami, *Applied Surface Science*, 2015, **330**, 85-93.

65. C. Li, Z. Xiong, J. Zhang and C. Wu, *Journal of Chemical Engineering Data*, 2015, **60**, 3414-3422.
66. X. Zhao, S. Liu, Z. Tang, H. Niu, Y. Cai, W. Meng, F. Wu and J. P. Giesy, *Scientific reports*, 2015, **5**, 1-10.
67. L.-N. Jin, X.-Y. Qian, J.-G. Wang, H. Aslan and M. Dong, *Journal of colloid interface science*, 2015, **453**, 270-275.
68. M.-L. Hu, L. Hashemi and A. Morsali, *Materials Letters*, 2016, **175**, 1-4.
69. C. Jiang, B. Fu, H. Cai and T. Cai, *Chemical Speciation Bioavailability*, 2016, **28**, 199-208.
70. Y. Shao, L. Zhou, C. Bao, J. Ma, M. Liu and F. Wang, *Chemical Engineering Journal*, 2016, **283**, 1127-1136.
71. M. S. Tehrani and R. Zare-Dorabei, *RSC advances*, 2016, **6**, 27416-27425.
72. X. Liu, W. Gong, J. Luo, C. Zou, Y. Yang and S. Yang, *Applied Surface Science*, 2016, **362**, 517-524.
73. X. Duan, J. Yu, Q. Zhang, Y. Cui, Y. Yang and G. Qian, *Materials Letters*, 2016, **185**, 177-180.
74. Z. Jiang and Y. Li, *Journal of the Taiwan Institute of Chemical Engineers*, 2016, **59**, 373-379.
75. T. Wang, P. Zhao, N. Lu, H. Chen, C. Zhang and X. Hou, *Chemical Engineering Journal*, 2016, **295**, 403-413.
76. X.-S. Wang, J. Liang, L. Li, Z.-J. Lin, P. P. Bag, S.-Y. Gao, Y.-B. Huang and R. Cao, *Inorganic chemistry*, 2016, **55**, 2641-2649.
77. V. Jabbari, J. Veleta, M. Zarei-Chaleshtori, J. Gardea-Torresdey and D. Villagrán, *Chemical Engineering Journal*, 2016, **304**, 774-783.
78. K. Wang, C. Li, Y. Liang, T. Han, H. Huang, Q. Yang, D. Liu and C. Zhong, *Chemical Engineering Journal*, 2016, **289**, 486-493.
79. T.-T. Zhu, Z.-M. Zhang, W.-L. Chen, Z.-J. Liu and E.-B. Wang, *RSC advances*, 2016, **6**, 81622-81630.
80. L. Li, Z. Shi, H. Zhu, W. Hong, F. Xie and K. Sun, *Water Science Technology*, 2016, **73**, 1728-1737.
81. J.-W. Sun, P.-F. Yan, G.-H. An, J.-Q. Sha, G.-M. Li and G.-Y. Yang, *Scientific reports*, 2016, **6**, 1-8.
82. S. Zhao, D. Chen, F. Wei, N. Chen, Z. Liang and Y. Luo, *Ultrasonics sonochemistry*, 2017, **39**, 845-852.
83. M. Y. Masoomi, M. Bagheri and A. Morsali, *Ultrasonics sonochemistry*, 2017, **37**, 244-250.
84. S. Aslam, J. Zeng, F. Subhan, M. Li, F. Lyu, Y. Li and Z. Yan, *Journal of Colloid Interface science*, 2017, **505**, 186-195.
85. J.-M. Yang, *Journal of colloid interface science*, 2017, **505**, 178-185.
86. A. Mohammadi, A. Alinejad, B. Kamarehie, S. Javan, A. Ghaderpoury, M. Ahmadpour and M. Ghaderpoori, *International Journal of Environmental Science Technology*, 2017, **14**, 1959-1968.
87. M. H. M. Tahir, S. E. Teo and P. Y. Moh, *Transactions on Science Technology*, 2017, **4**, 14-21.
88. R. Wang, C. Ge, T. Xing, Y. Zhang, Y. Zhang and X. Zhang, *Applied Organometallic Chemistry*, 2017, **31**, e3798.
89. M. R. Azhar, H. R. Abid, H. Sun, V. Periasamy, M. O. Tadé and S. Wang, *Journal of colloid interface science*, 2017, **490**, 685-694.
90. S. Chand, S. M. Elahi, A. Pal and M. C. Das, *Dalton Transactions*, 2017, **46**, 9901-9911.

91. J. Huang, H. Song, C. Chen, Y. Yang, N. Xu, X. Ji, C. Li and J.-A. You, *Journal of environmental chemical engineering*, 2017, **5**, 2579-2585.
92. S. Yao, T. Xu, N. Zhao, L. Zhang, Q. Huo and Y. Liu, *Dalton Transactions*, 2017, **46**, 3332-3337.
93. H. Li, X. Cao, C. Zhang, Q. Yu, Z. Zhao, X. Niu, X. Sun, Y. Liu, L. Ma and Z. Li, *RSC advances*, 2017, **7**, 16273-16281.
94. J. Abdi, M. Vossoughi, N. M. Mahmoodi and I. Alemzadeh, *Chemical Engineering Journal*, 2017, **326**, 1145-1158.
95. H. Li, Q. Li, Y. He, Z. Xu and Q. Tang, *New Journal of Chemistry*, 2017, **41**, 15204-15209.
96. W. G. Jin, W. Chen, P. H. Xu, X. W. Lin, X. C. Huang, G. H. Chen, F. Lu and X. M. Chen, *Chemistry–A European Journal*, 2017, **23**, 13058-13066.
97. N. Chen, D. Chen, F. Wei, S. Zhao and Y. Luo, *Chemical Physics Letters*, 2018, **705**, 23-30.
98. H. Molavi, A. Hakimian, A. Shojaei and M. Raeiszadeh, *Applied Surface Science*, 2018, **445**, 424-436.
99. J. Zhang, F. Li and Q. Sun, *Applied Surface Science*, 2018, **440**, 1219-1226.
100. L. Huang, M. He, B. Chen and B. Hu, *Chemosphere*, 2018, **199**, 435-444.
101. H. Tian, J. Peng, T. Lv, C. Sun and H. He, *Journal of Solid State Chemistry*, 2018, **257**, 40-48.
102. M. Oveisi, M. A. Asli and N. M. Mahmoodi, *Journal of hazardous materials*, 2018, **347**, 123-140.
103. L. Zeng, L. Xiao, Y. Long and X. Shi, *Journal of colloid interface science*, 2018, **516**, 274-283.
104. S. A. Hosseinpour, G. Karimipour, M. Ghaedi and K. Dashtian, *Applied Organometallic Chemistry*, 2018, **32**, e4007.
105. J. Cai, X. Mao and W.-G. Song, *Materials Chemistry Frontiers*, 2018, **2**, 1389-1396.
106. J. Fan, D. Chen, N. Li, Q. Xu, H. Li, J. He and J. Lu, *Chemosphere*, 2018, **191**, 315-323.
107. M. A. Karimi, H. Masrouri, M. A. Mirbagheri, S. Andishgar and T. Pourshamsi, *Journal of the Chinese Chemical Society*, 2018, **65**, 1229-1238.
108. Z. Wang, J.-H. Zhang, J.-J. Jiang, H.-P. Wang, Z.-W. Wei, X. Zhu, M. Pan and C.-Y. Su, *Journal of Materials Chemistry A*, 2018, **6**, 17698-17705.
109. A. A. Alqadami, M. Naushad, Z. Alothman and T. Ahamad, *Journal of environmental management*, 2018, **223**, 29-36.
110. A. Jarrah and S. Farhadi, *RSC Advances*, 2018, **8**, 37976-37992.
111. T.-T. Li, Y.-M. Liu, T. Wang, Y.-L. Wu, Y.-L. He, R. Yang and S.-R. Zheng, *Microporous Mesoporous Materials*, 2018, **272**, 101-108.
112. Z. Li, G. Zhou, H. Dai, M. Yang, Y. Fu, Y. Ying and Y. Li, *Journal of Materials Chemistry A*, 2018, **6**, 3402-3413.
113. Y.-H. Fan, S.-W. Zhang, S.-B. Qin, X.-S. Li and S.-H. Qi, *Microporous Mesoporous Materials*, 2018, **263**, 120-127.
114. K.-W. Jung, B. H. Choi, S. Y. Lee, K.-H. Ahn and Y. J. Lee, *Journal of Industrial Engineering Chemistry*, 2018, **67**, 316-325.
115. M. S. Embaby, S. D. Elwany, W. Setyaningsih and M. R. Saber, *Chinese journal of chemical engineering*, 2018, **26**, 731-739.
116. A. V. Desai, A. Roy, P. Samanta, B. Manna and S. K. Ghosh, *Iscience*, 2018, **3**, 21-30.
117. K. Y. A. Lin, H. Yang and F. K. Hsu, *Water Environment Research*, 2018, **90**, 144-154.

118. S. Luo and J. Wang, *Environmental Science Pollution Research*, 2018, **25**, 5521-5528.
119. S. Liu, M. Guo, H. Guo, Y. Sun, X. Guo, S. Sun and E. V. Alexandrov, *RSC advances*, 2018, **8**, 4039-4048.
120. M. Yang and Q. Bai, *Colloids Surfaces A: Physicochemical Engineering Aspects*, 2019, **582**, 123795.
121. T. Noor, U. Raffi, N. Iqbal, L. Yaqoob and N. Zaman, *Materials Research Express*, 2019, **6**, 125088.
122. Q. Yang, B. Wang, Y. Chen, Y. Xie and J. Li, *Chinese Chemical Letters*, 2019, **30**, 234-238.
123. V. D. Doan, T. L. Do, T. M. T. Ho, V. T. Le and H. T. Nguyen, *Separation Science Technology*, 2020, **55**, 444-455.
124. S. A. Sadat, A. M. Ghaedi, M. Panahimehr, M. M. Baneshi, A. Vafaei and M. Ansarizadeh, *Applied Surface Science*, 2019, **467**, 1204-1212.
125. M. Trukawka, K. Cendrowski, M. Peruzynska, A. Augustyniak, P. Nawrotek, M. Drozdzik and E. Mijowska, *Environmental Sciences Europe*, 2019, **31**, 1-15.
126. M. Hasanzadeh, A. Simchi and H. S. Far, *Materials Chemistry Physics*, 2019, **233**, 267-275.
127. H. Duo, H. Tang, J. Ma, X. Lu, L. Wang and X. Liang, *New Journal of Chemistry*, 2019, **43**, 15351-15358.
128. X. Duan, R. Lv, Z. Shi, C. Wang, H. Li, J. Ge, Z. Ji, Y. Yang, B. Li and G. Qian, *Journal of Solid State Chemistry*, 2019, **277**, 159-162.
129. S. Yoon, J. J. Calvo and M. C. So, *Crystals*, 2019, **9**, 17.
130. Z.-h. Zhang, J.-l. Zhang, J.-m. Liu, Z.-h. Xiong and X. Chen, *Water, Air, Soil Pollution*, 2016, **227**, 1-12.
131. N. M. Mahmoodi, M. Oveisi and E. Asadi, *Journal of Cleaner Production*, 2019, **211**, 198-212.
132. M. Sarker, S. Shin, J. H. Jeong and S. H. Jhung, *Chemical Engineering Journal*, 2019, **371**, 252-259.
133. Y. Tan, Z. Sun, H. Meng, Y. Han, J. Wu, J. Xu, Y. Xu and X. Zhang, *Separation Purification Technology*, 2019, **215**, 217-226.
134. Q. Zhang, M. Wahiduzzaman, S. Wang, S. Henfling, N. Ayoub, E. Gkaniatsou, F. Nouar, C. Sicard, C. Martineau and Y. Cui, *Chem*, 2019, **5**, 1337-1350.
135. S.-Q. Deng, Y.-L. Miao, Y.-L. Tan, H.-N. Fang, Y.-T. Li, X.-J. Mo, S.-L. Cai, J. Fan, W.-G. Zhang and S.-R. Zheng, *Inorganic chemistry*, 2019, **58**, 13979-13987.
136. A. Hamedi, M. B. Zarandi and M. R. Nateghi, *Journal of Environmental Chemical Engineering*, 2019, **7**, 102882.
137. R. Guo, X. Cai, H. Liu, Z. Yang, Y. Meng, F. Chen, Y. Li and B. Wang, *Environmental science technology*, 2019, **53**, 2705-2712.
138. N. M. Mahmoodi, M. Taghizadeh and A. Taghizadeh, *Korean Journal of Chemical Engineering*, 2019, **36**, 287-298.
139. Y. Liu, Y. Huang, A. Xiao, H. Qiu and L. Liu, *Nanomaterials*, 2019, **9**, 51.
140. Q. Zhang, X. Jiang, A. M. Kirillov, Y. Zhang, M. Hu, W. Liu, L. Yang, R. Fang and W. Liu, *ACS Sustainable Chemistry Engineering*, 2019, **7**, 3203-3212.
141. C. Arora, S. Soni, S. Sahu, J. Mittal, P. Kumar and P. Bajpai, *Journal of Molecular Liquids*, 2019, **284**, 343-352.
142. J. Liu, H. Yu and L. Wang, *Journal of hazardous materials*, 2020, **392**, 122274.
143. R. Pei, L. Fan, F. Zhao, J. Xiao, Y. Yang, A. Lai, S.-F. Zhou and G. Zhan, *Journal of hazardous materials*, 2020, **384**, 121418.

144. X. Liu, B. Liu, J. F. Eubank and Y. Liu, *Materials Chemistry Frontiers*, 2020, **4**, 182-188.
145. S.-Y. Fang, P. Zhang, J.-L. Gong, L. Tang, G.-M. Zeng, B. Song, W.-C. Cao, J. Li and J. Ye, *Chemical Engineering Journal*, 2020, **385**, 123400.
146. M. D. Firouzjaei, F. A. Afkhami, M. R. Esfahani, C. H. Turner and S. Nejati, *Journal of Water Process Engineering*, 2020, **34**, 101180.
147. M. Zhong, S.-Y. Qu, K. Zhao, P. Fei, M.-M. Wei, H. Yang and B. Su, *ChemistrySelect*, 2020, **5**, 1858-1864.
148. B. Sherino, S. N. Abdul Halim, S. Shahabuddin and S. Mohamad, *Separation Science Technology*, 2021, **56**, 330-343.
149. N. M. Mahmoodi, M. Oveisi, A. Taghizadeh and M. Taghizadeh, *Carbohydrate polymers*, 2020, **227**, 115364.
150. M. Hasanzadeh, A. Simchi and H. S. Far, *Journal of Industrial Engineering Chemistry*, 2020, **81**, 405-414.
151. M. M. Baneshi, A. M. Ghaedi, A. Vafaei, D. Emadzadeh, W. J. Lau, H. Marioryad and A. Jamshidi, *Environmental research*, 2020, **183**, 109278.
152. J. Zolgharnein, S. D. Farahani, M. Bagtash and S. Amani, *Environmental research*, 2020, **182**, 109054.
153. M. Firoozi, Z. Rafiee and K. Dashtian, *ACS omega*, 2020, **5**, 9420-9428.
154. H. Xue, X.-S. Huang, Q. Yin, X.-J. Hu, H.-Q. Zheng, G. Huang and T.-F. Liu, *Crystal Growth  Design*, 2020, **20**, 4861-4866.
155. M. Saghian, S. Dehghanpour and M. Sharbatdaran, *RSC Advances*, 2020, **10**, 9369-9377.
156. I. Mantasha, M. Shahid, H. A. Saleh, K. M. Qasem and M. Ahmad, *CrystEngComm*, 2020, **22**, 3891-3909.
157. G. Kumar and D. T. Masram, *ACS omega*, 2021, **6**, 9587-9599.
158. E. Jin, J. Kim, J. Nam, D. C. Yang, H. Jeong, S. Kim, E. Kang, H. J. Cho and W. Choe, *ACS Applied Nano Materials*, 2021, DOI: 10.1021/acsanm.1c01450.
159. K. E. Diab, E. Salama, H. S. Hassan, A. Abd El-moneim and M. F. Elkady, *Scientific reports*, 2021, **11**, 1-13.
160. S. Kumar, S. Liu, B. Mohan, M. Zhang, Z. Tao, Z. Wan, H. You, F. Sun, M. Li and P. Ren, *Inorganic Chemistry*, 2021, **60**, 7070-7081.