

Supplementary information for the manuscript

One-pot coating of LiCoPO_4/C by UiO-66 metal-organic framework

Abdelaziz M. Aboraia^{1,2,*}, Viktor V. Shapovalov¹, Alexnader A. Guda^{1,*}, Vera V. Butova^{1,3},
Alexander Soldatov¹

¹The Smart Materials Research Institute, Southern Federal University, Sladkova 178/24, 344090, Rostov-on-Don, Russia.

²Department of Physics, Faculty of Science, Al-Azhar University, Assiut 71542, Egypt.

³Federal Research Center of the Southern Scientific Center of the Russian Academy of Sciences, 344006, Rostov-on-Don, the Russian Federation

Corresponding authors: a.m.aboraia@gmail.com, guda@sfedu.ru

S1. Impedance analysis

Impedance spectral analysis is a well-adopted method to investigate the response of dielectric as a function of frequency and temperature and obtain a wealth of information on ionic— and electronically—conducting solids. The electrical response of the sample is usually manifested as capacitive and resistive behaviors attributed predominantly to the bulk grains, the grain boundaries, or the defects present at the sample– electrode interface. Figure S1 exhibited the Z' versus $-Z''$ for LiCoPO_4/C since the bulk resistance at around $3\text{M}\Omega$ and this comparable to¹, However, the bulk resistance of $\text{LiCoPO}_4/\text{C}@UiO-66$ is around $10\text{K}\Omega$, thus the UiO-66 enhance the electronic Conductivity of LiCoPO_4 as shown inset figure S1.

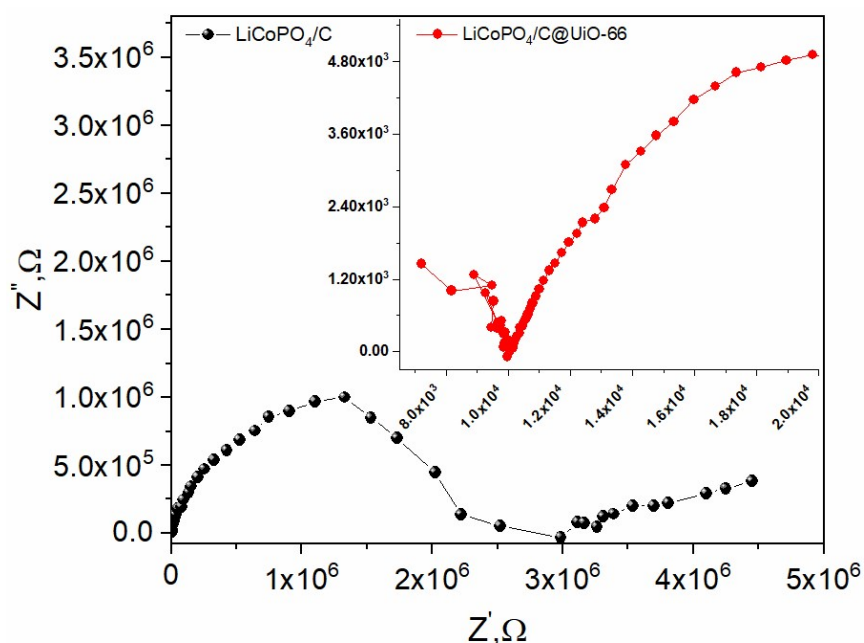


Figure S1: A complex impedance spectrum of LiCoPO_4/C and $\text{LiCoPO}_4/\text{C}@UiO-66$ (inset) at room temperature.

S2. X-ray fluorescence analysis

The XRF analysis was performed using Bruker M4-Tornado X-ray fluorescence spectrometer operated at 50 kV tube voltage, 300 μ A tube current, and Rh anode. Measurements were performed under mild vacuum conditions – the air pressure below 10 mbar. The device operates with microfocusing polycapillary optics so acquisitions in several points were collected and averaged. Quantification of the elemental composition is provided in Table 1.

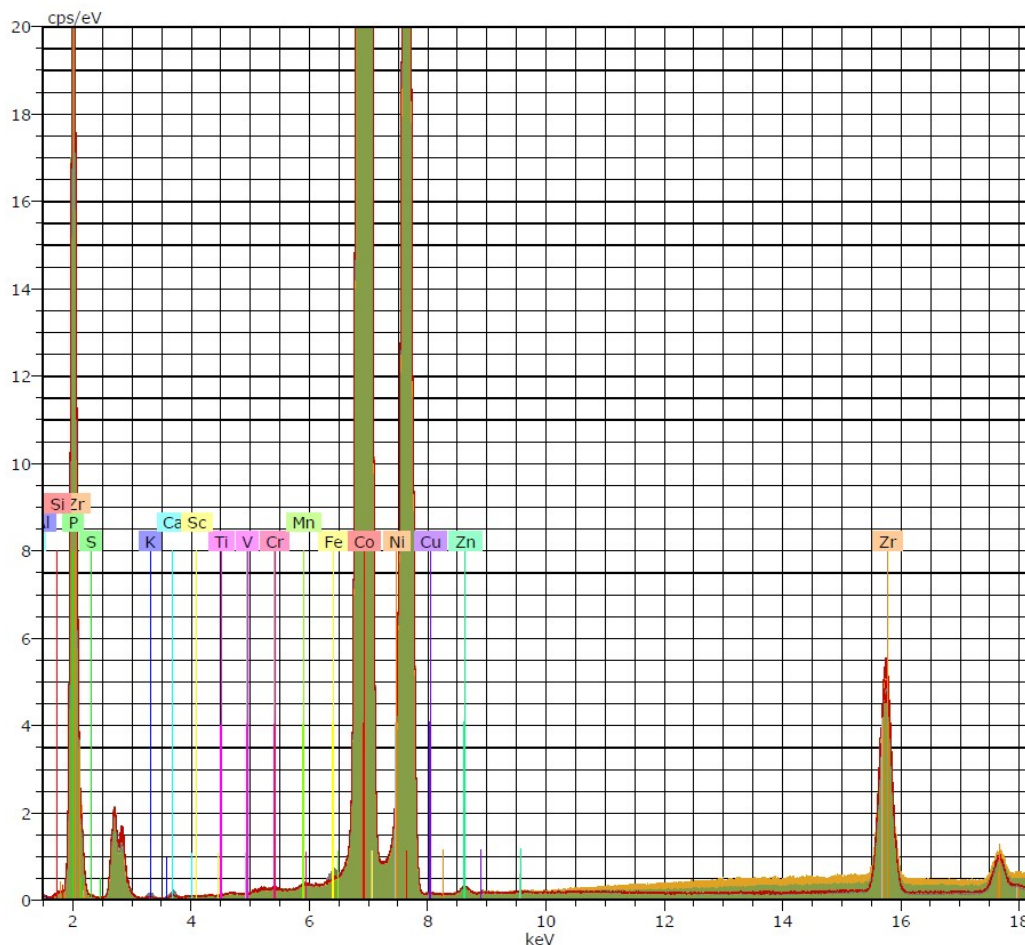


Figure S2. XRF spectrum of the sample

Table 1. Mass percent(%) of elements in the sample according to the X-ray fluorescence analysis

| Mg | Al | Si | P | S | K | Ca | Sc | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Zr |
|----|-----|----|----|---|---|----|----|----|---|----|----|----|------|-----|----|-----|-----|
| 0 | 0.2 | 0 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 66.8 | 0.2 | 0 | 0.1 | 3.7 |

S3. X-ray photoelectron spectroscopy

XPS spectra were measured using ESCALab 5 (Vacuum Generators) spectrometer. The thin layer of sample powder was placed on carbon tape and evacuated overnight before the acquisition. During the measurements, the dynamic charging effect was observed which made line profile analysis difficult. In figure S3 we provide an overview spectrum in a wide binding energy range. The spectrum confirms the presence of phosphorous, cobalt, and zirconium in the sample. According to the bulk sensitive XRF probe the mass concentration of Zr is almost 20 times smaller

than Co. However, the areas for lines of Co and Zr in surface-sensitive XPS spectrum are comparable. Neglecting different cross-sections for the corresponding transition the qualitative comparison of obtained results allows us to conclude that Zr is mainly situated on the surface of the sample that improves the efficiency of photoelectrons to reach the detector.

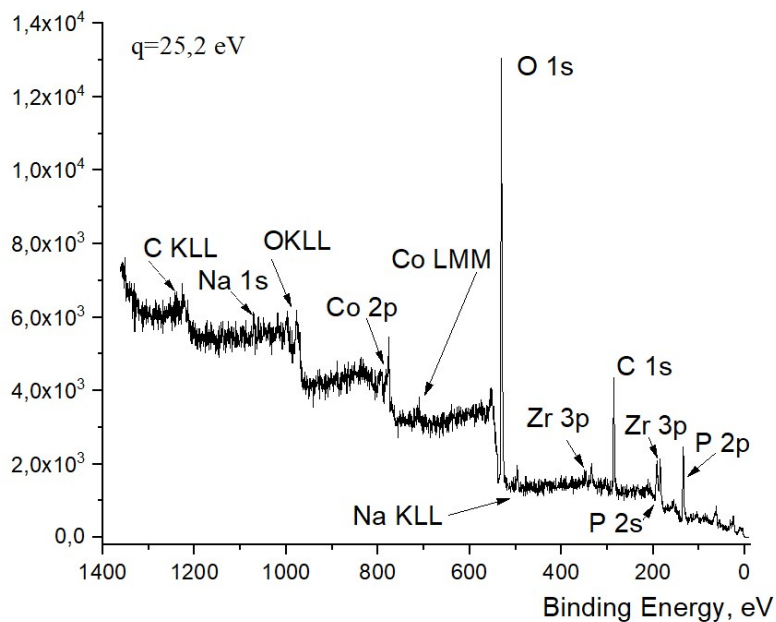


Figure S3. Overview XPS spectrum of the as-synthesized sample powder.

References:

1. M. V. Reddy, M. V. Reddy, M. V. Reddy and B. V. R. Chowdari, *Journal of Solid State Electrochemistry*, 2012, **16**, 1833-1839.