Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.


# Solution processing of highly conductive ruthenium and ruthenium oxide thin films from ruthenium-amine complexes

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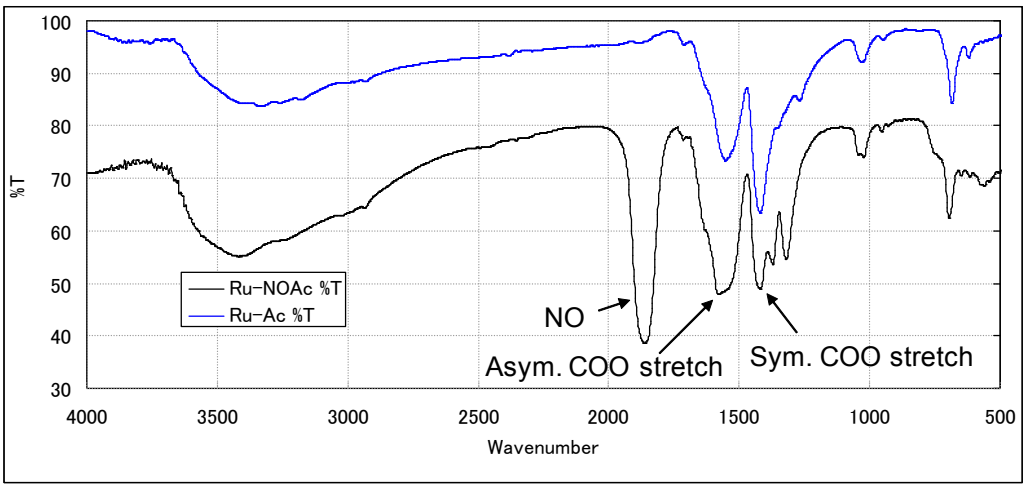
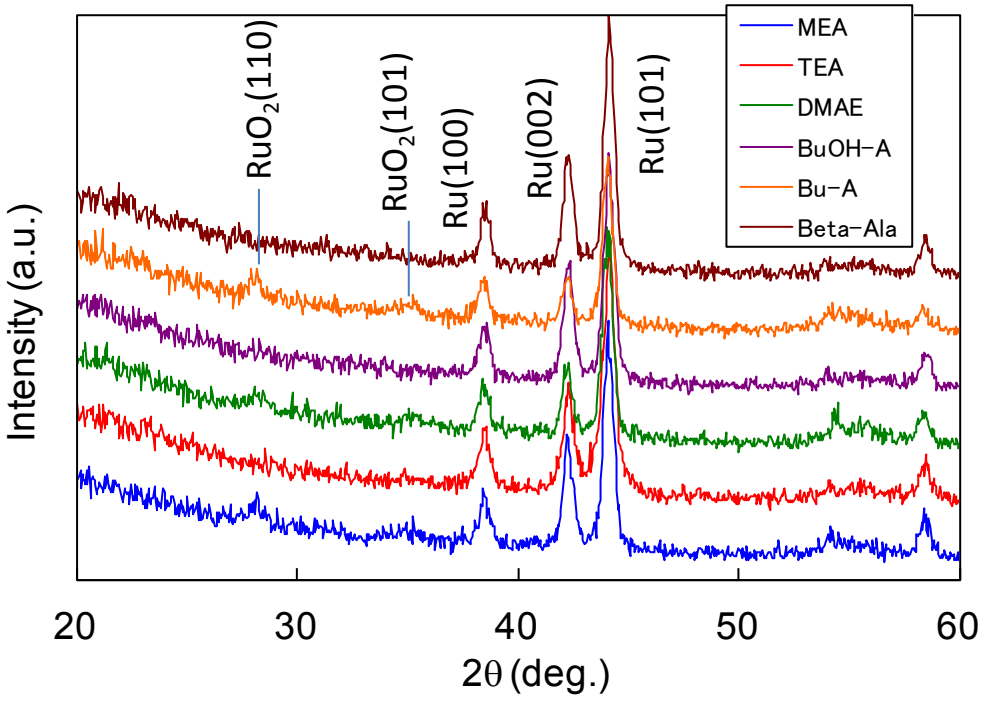
## Supplementary Information

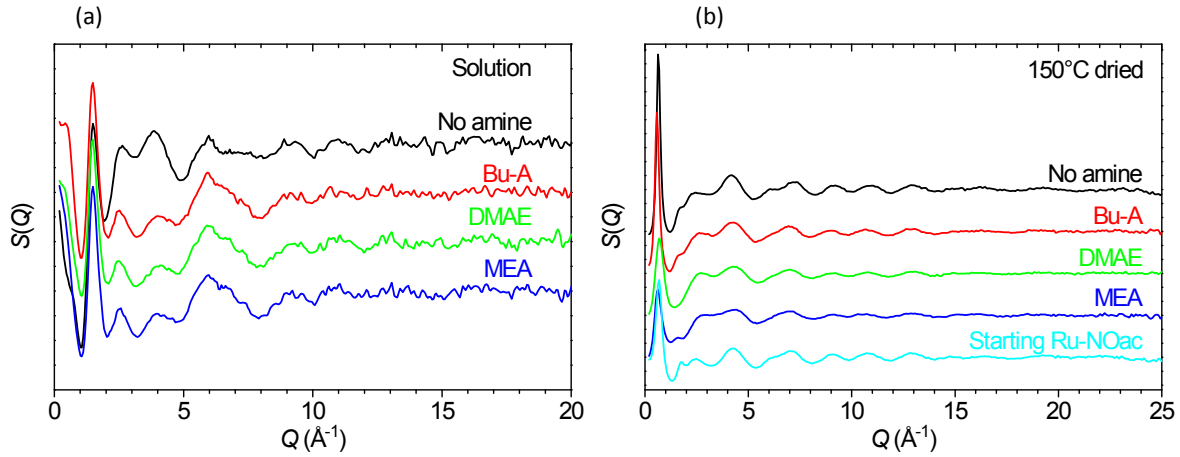
## Supplementary Figures



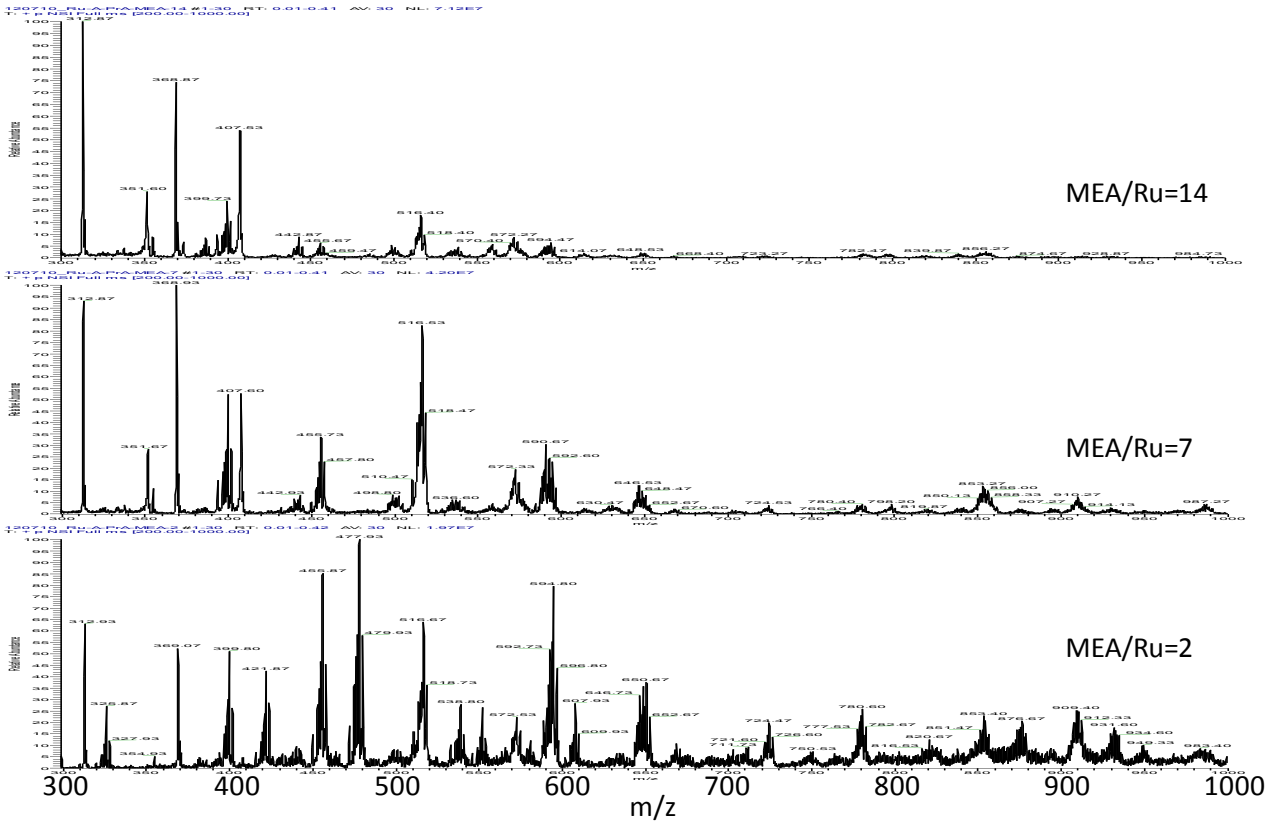

**Supplementary Figure S1.** FTIR spectra of ruthenium nitrosyl scetate (Ru-NOAc) and ruthenium acetate (Ru-Ac), indicating the band positions of NO and COO.



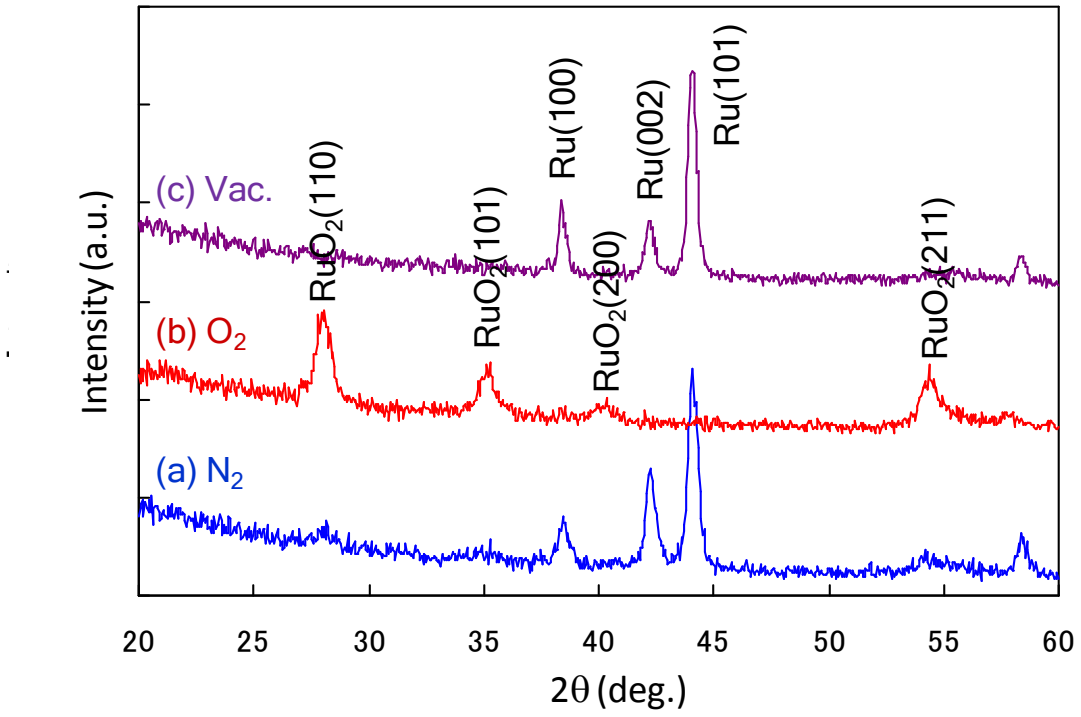

**Supplementary Figure S2.** XRD patterns of thin films prepared from solutions with different amines and annealed at 500°C in $N_2$.



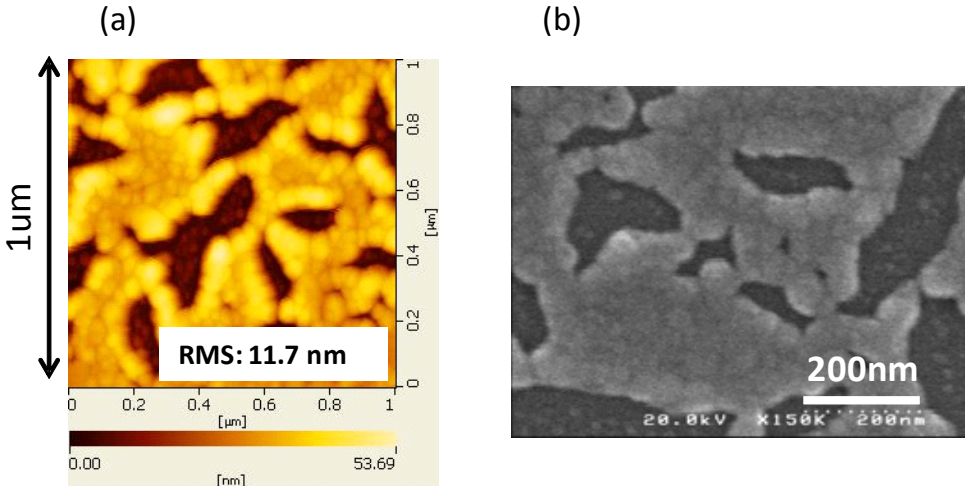

**Supplementary Figure S**3. Total structure factors, *S*(*Q*), of the solutions with different amines (a) and of their 150°C-dried gels (b). The data for the starting material, ruthenium nitrosyl acetate, is presented in (b) as reference.



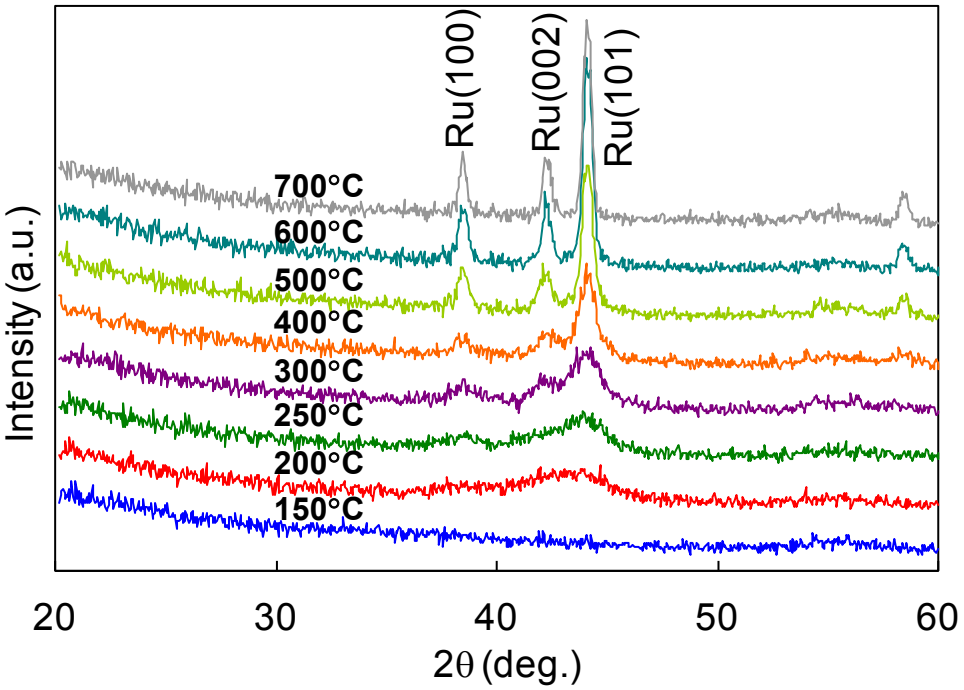

**Supplementary Figure S4.** EI-MS spectra of solutions with different amount of MEA. Complexes may have partially dissociated during ionization without cooling.



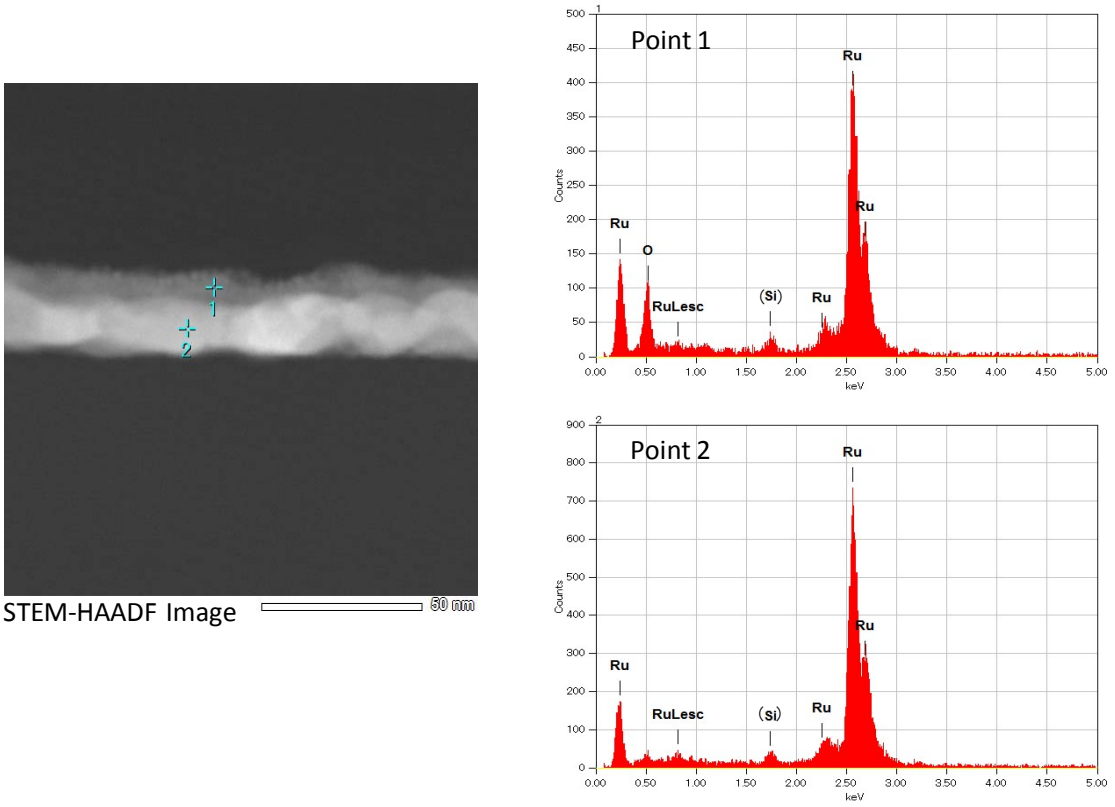

**Supplementary Figure S5.** XRD spectra of the thin films prepared from the precursor solution with MEA/Ru = 2 in (a) nitrogen, (b) oxygen and (c) vacuum at 500 °C for 10min.



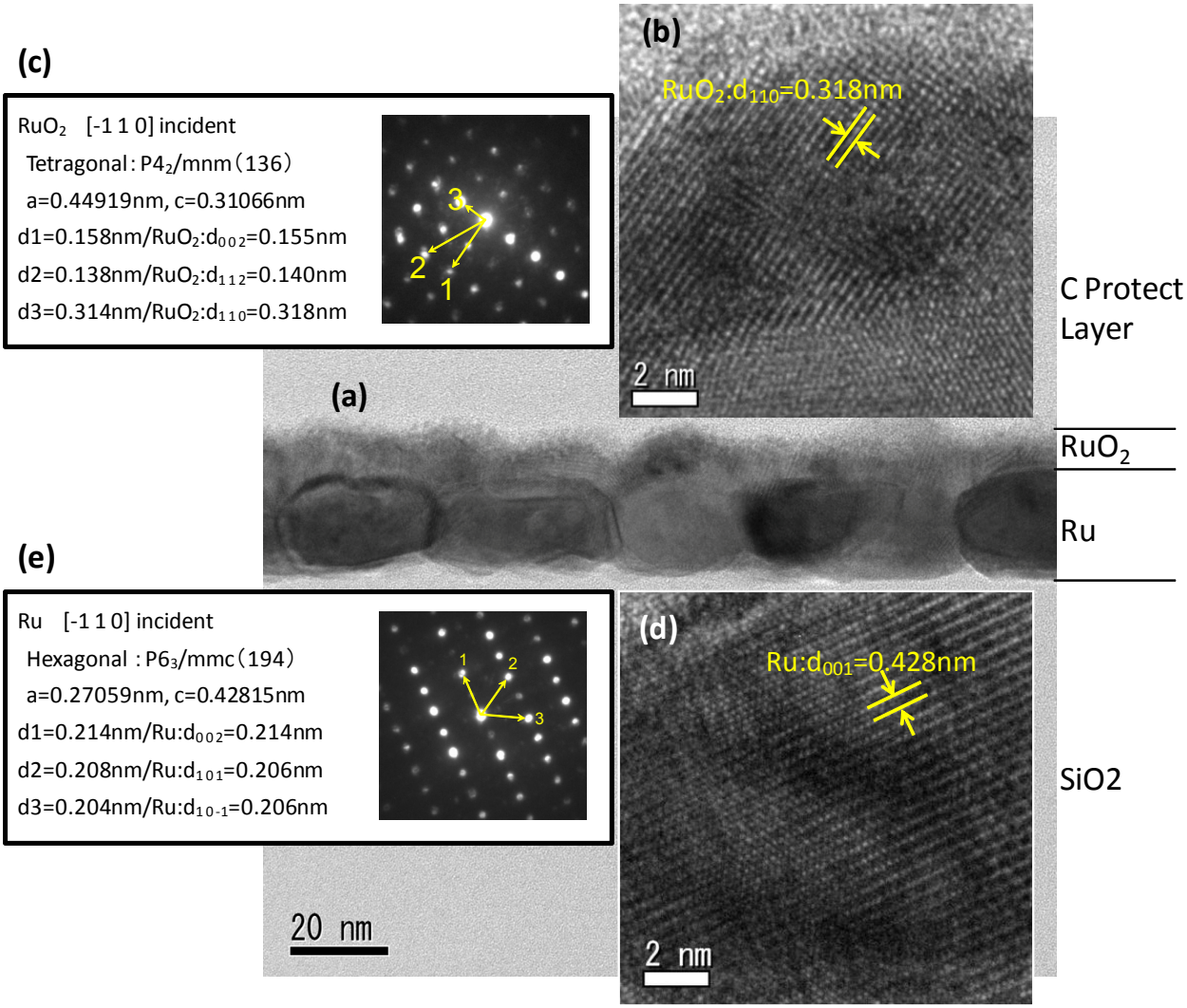

**Supplementary Figure S6.** AFM (a) and SEM (b) Images of the thin films prepared at 500° C for 10 min in vacuum from the precursor solution with MEA/Ru = 2.



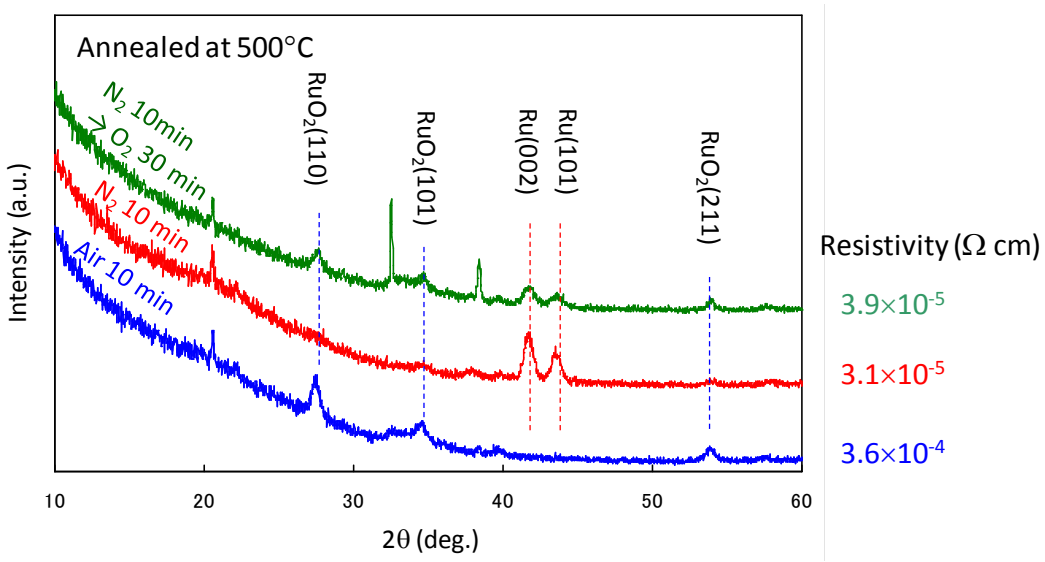

**Supplementary Figure S7.** XRD patterns of thin films prepared from the solution with MEA/Ru = 2 in vacuum at various annealing temperatures for 10 min.



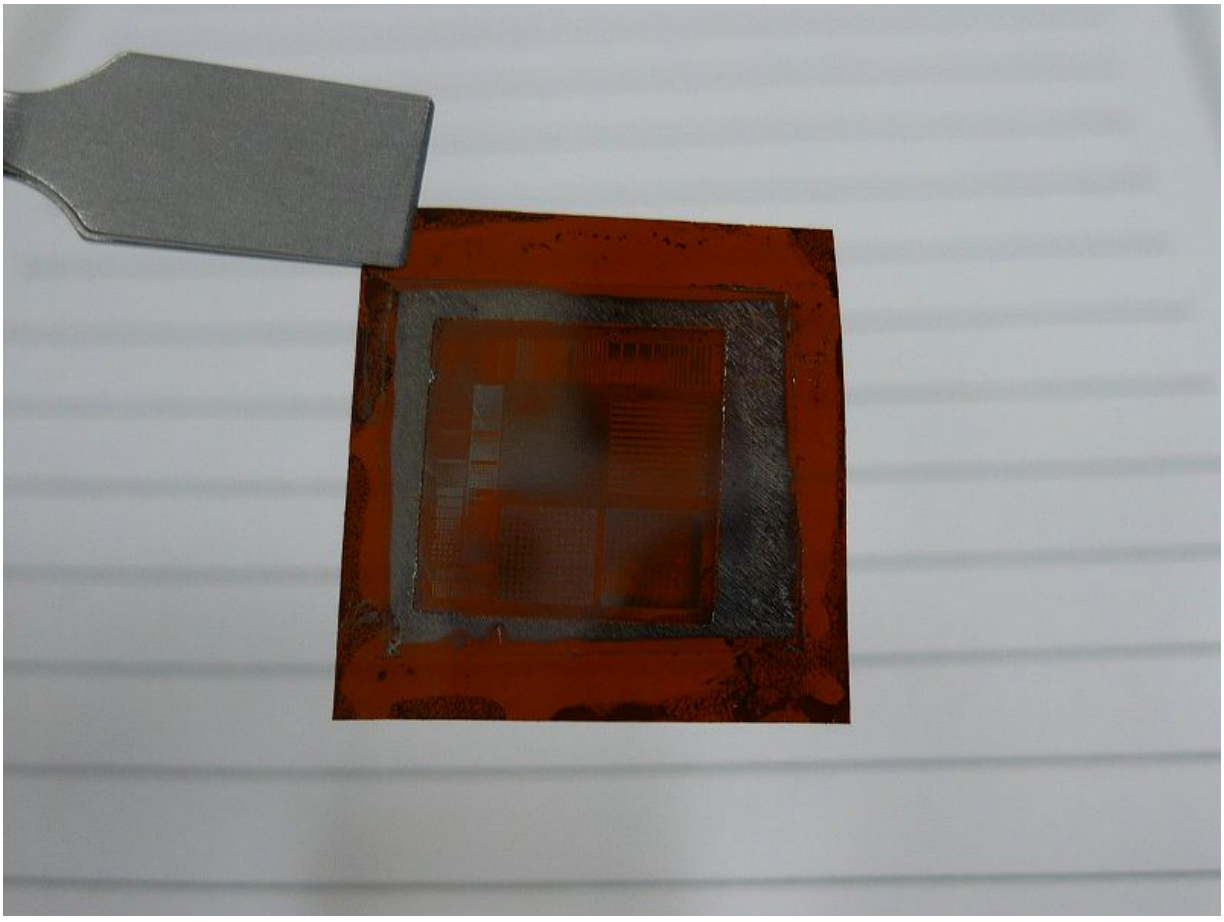

**Supplementary Figure S8.** EDX point analysis of the film prepared in nitrogen at 500°C from the solution with MEA/Ru = 2.




**Supplementary Figure S9.** TEM analysis of the film prepared in nitrogen at 500° C from the solution with MEA/Ru = 2. (a) Overview. (b and d) High resolution images of the surface $RuO_2$ (b) and the Ru metal film (d). (c and e) Nano-beam electron diffraction of the surface $RuO_2$ (c) and the Ru metal film (e).




**Supplementary Figure S10.** XRD patterns and resistivity of thin films prepared from the solutions with MEA/Ru = 2.



**Supplementary Figure S11.** Photograph of $Ru^0$ patterns directly imprinted on a polyimide substrate.