# A facile synthesis of multi metal-doped rectangular ZnO nanocrystals by using a nanocrystalline metal-organic frameworks template

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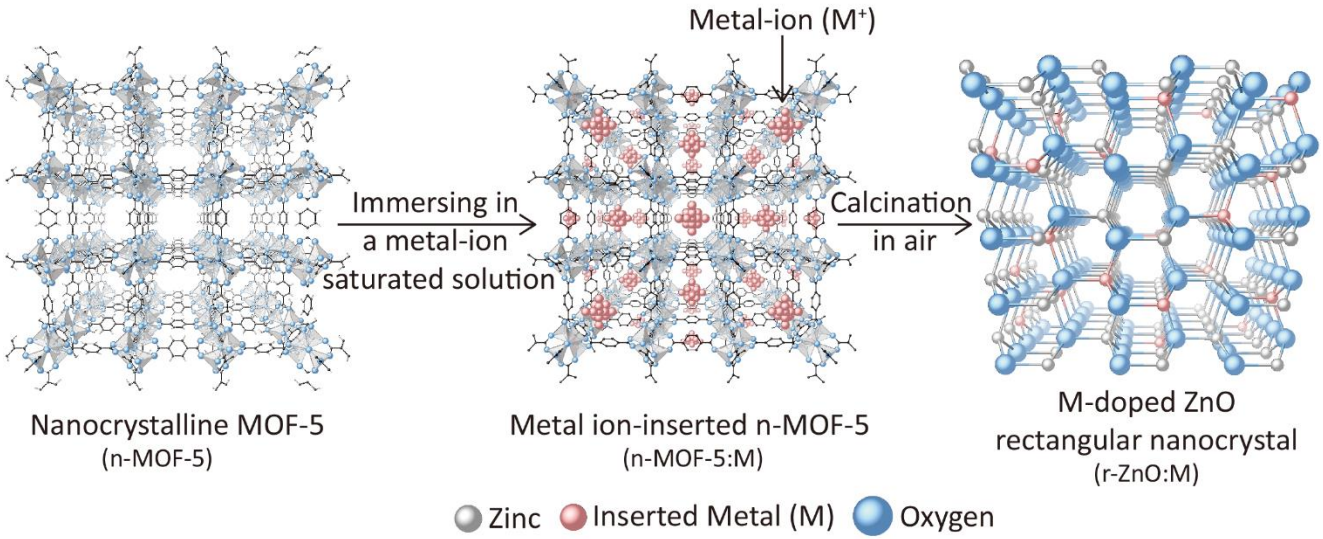
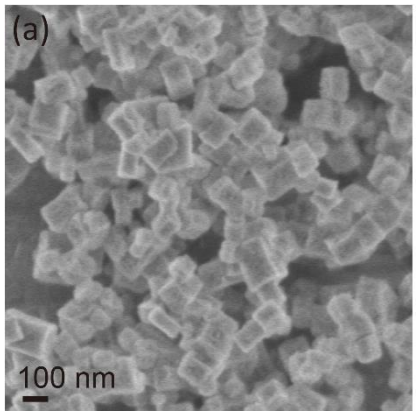
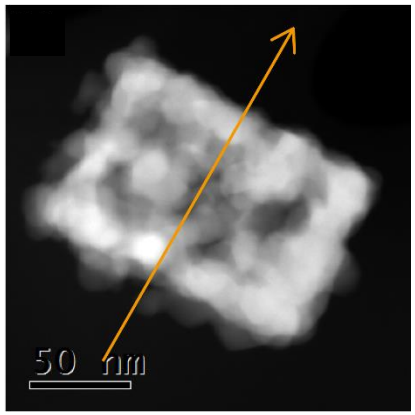


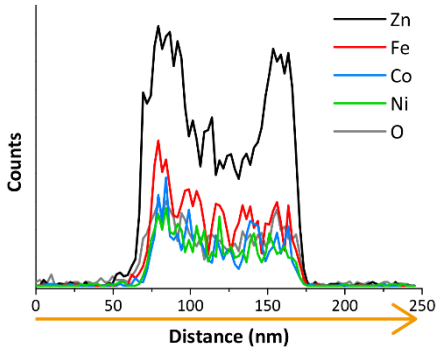

**Nanocrystalline MOF-5**



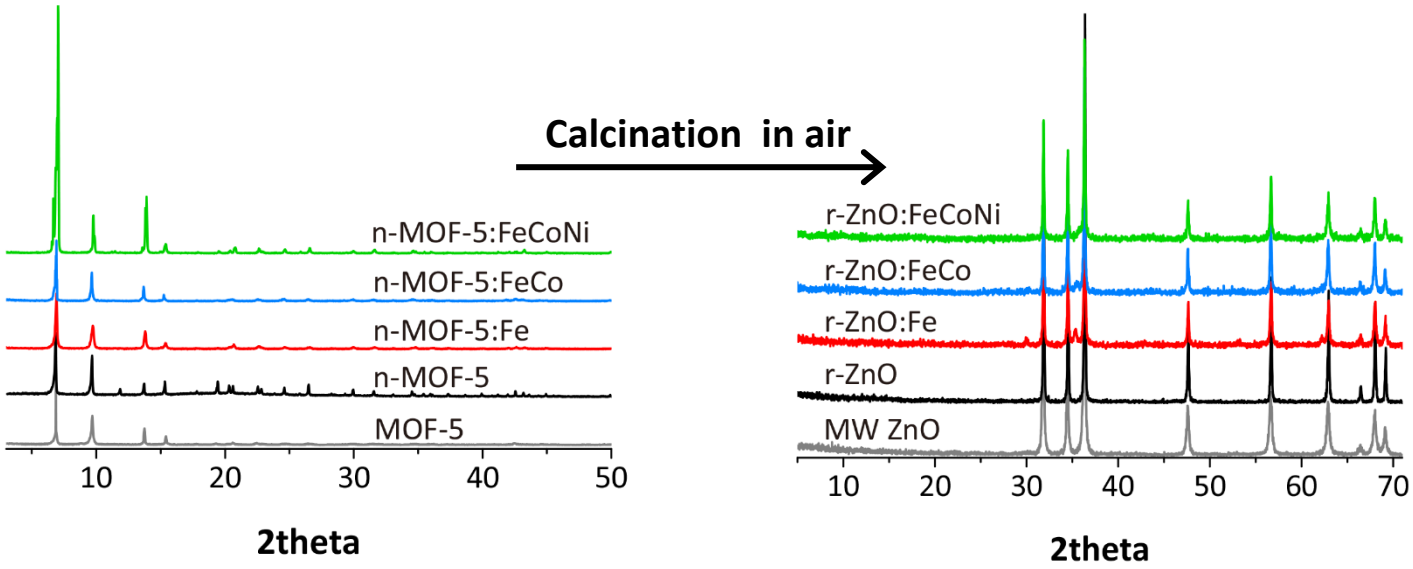

**Insertion of metal ion**
**Calcination in air**

**Rectangular Fe, Co, and Ni-doped ZnO nanocrystal**

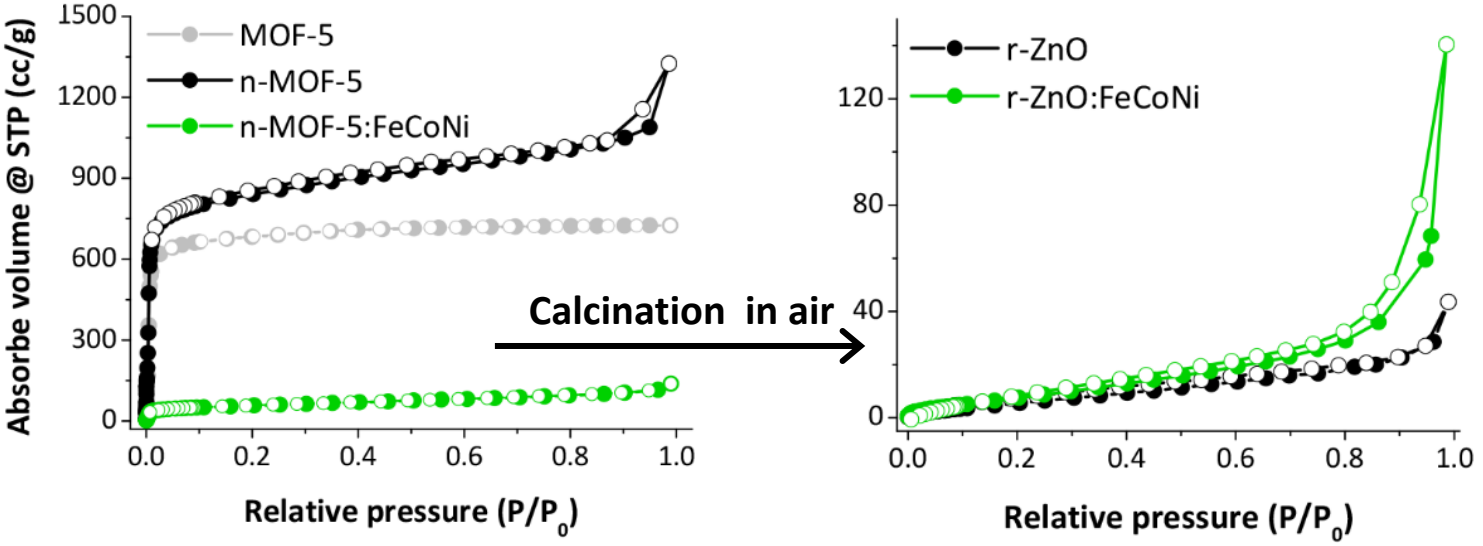


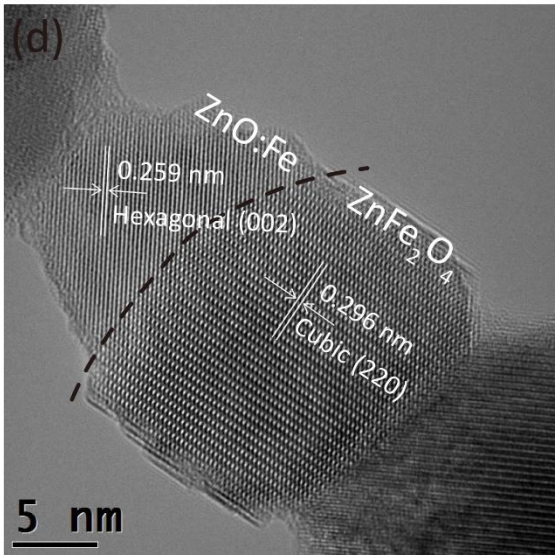
## Crystal structure before and after calcination

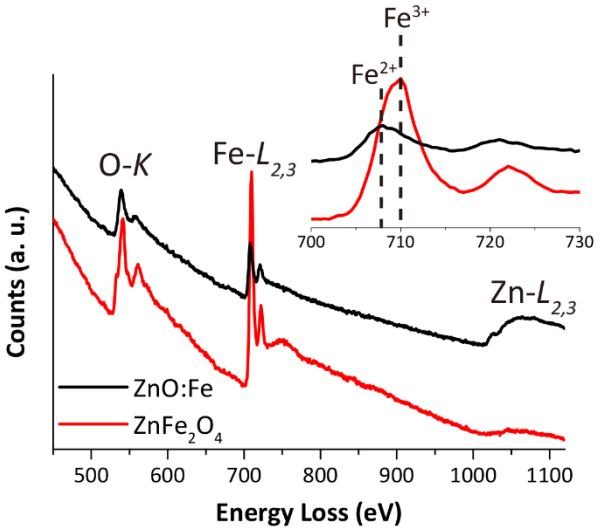



## $N_2$ adsorption(●)-desorption(○) isotherms at 77K



## HR-TEM image and EELS results of the Fe-doped ZnO Nanocrystal



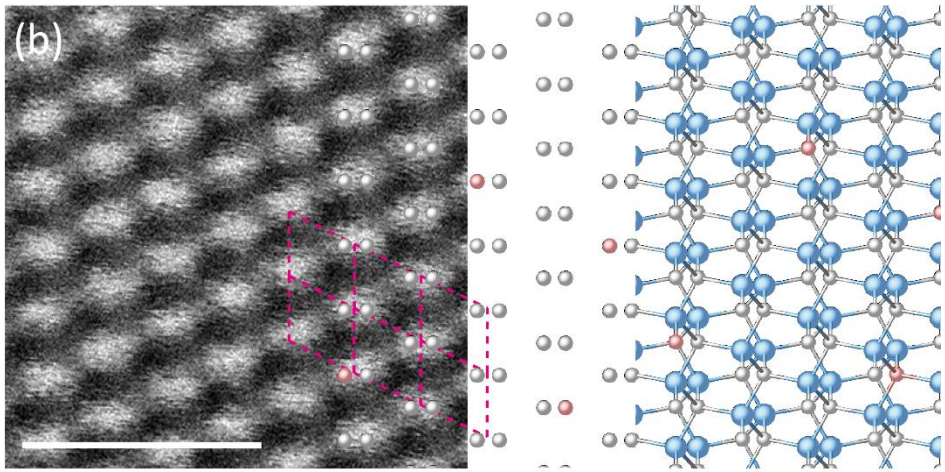




## Atomic arrangements in the Fe-doped ZnO Nanocrystal

Atomic arrangement of wurtzite (2111) in ZnO:Fe region

w/o oxygen

w/ oxygen

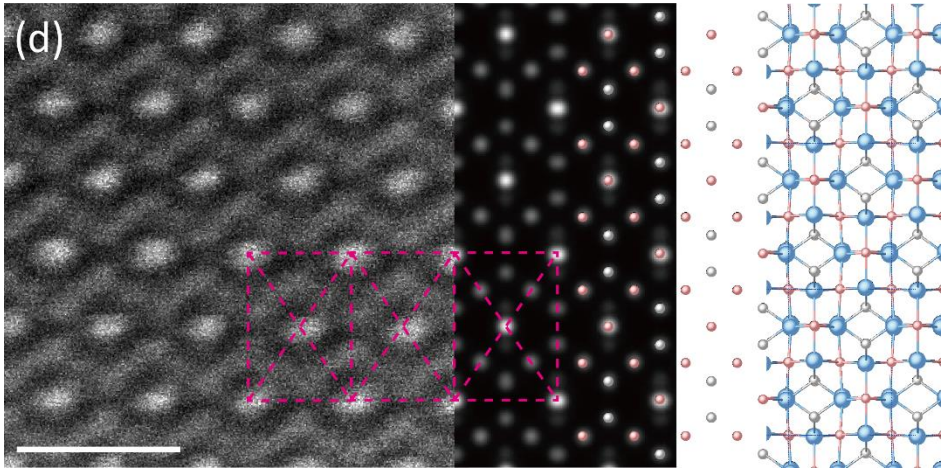



Atomic arrangement of spine (101) in $ZnFe_2O_4$ region

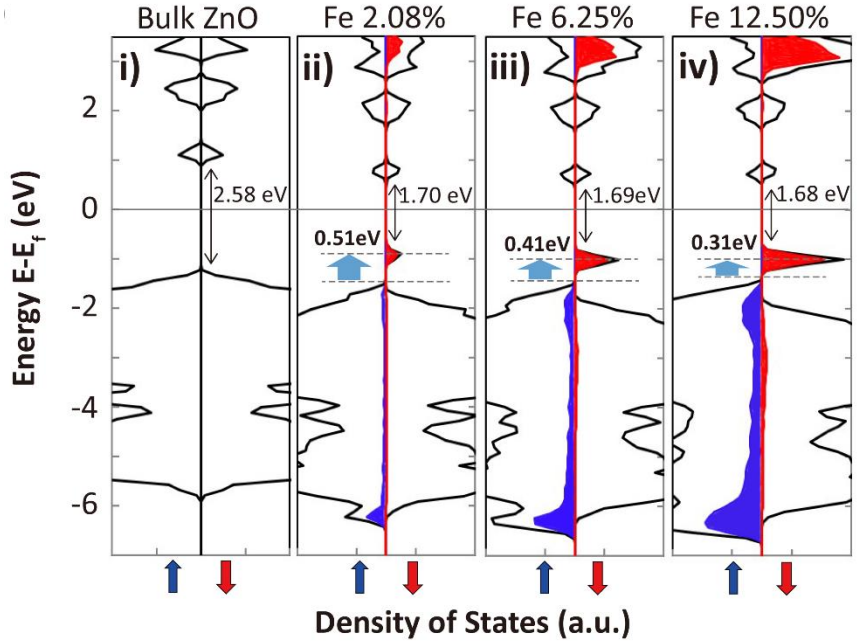
Simulated HAADF

w/o oxygen

w/ oxygen



## Change of spin-dependent density of states by Fe dopant




## Change of absorbance and magnetic characteristics depend on the dopants