MS24-P05 | UNDERSTANDING AND TUNING MAGNETISM OF MESOSCOPIC HOLLOW OXIDE SPHERE BY SURFACE ENGINEERING

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In this study, magnetism of mesoscopic hollow ceria spheres was revealed. Hollow microspheres were synthesized by spray pyrolysis and then undergone various post process, including surface treatment and annealing. At first, TEM observations show that the synthesized hollow spheres have a diameter of 50 nm to 2 μm and a shell thickness of about 30 to 40 nm. Raman spectroscopy and STEM/EELS analysis indicated that the defects were mainly oxygen vacancy (V_O) and the reduced cerium (Ce^{3+}). Both were found to concentrate in the surface layer of about 2 nm and the distribution trend was independent of the size of the hollow sphere. After the post treatment, the size, porosity, and defect concentration of the shell changed. However, the distribution of defect keeps the same, it still concentrated in the range of 2 nm from the surface. Magnetic measurement demonstrated that synthesized hollow ceria spheres were ferromagnetic at room temperature. Unusual size effect on magnetism was noted in present hollow spheres as comparing to nanoparticle and bulk systems. The value of saturation magnetization (M_s) of the large spheres (larger than 800 nm) is an order of magnitude higher than that of the small ones. After post treatment, M_s could be further enhanced. The highest saturation magnetization was obtained in the sample subjected to react with HNO_3 for 15 minutes, which was attributed to the optimized surface state. At last, the structure-magnetism dependence observed in present study will be discussed by the giant orbital paramagnetic model.