Control of the pore size distribution inside the RuO_2 catalyst by using silica nanosphere particle for highly efficient water electrolysis

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As the renewable energy generation increases, the storage of extra electricity is becoming an important challenge due to the instability of photovoltaic and wind generation. Among many approaches, hydrogen production through water electrolysis features the advantages of long-term storability. IrO_2 and RuO_2, which are the useful catalysts for proton exchange membrane water electrolysis (PEMWE) at present, were developed intensely to overcome the sluggish OER kinetics and stability. In this study, the RuO_2 catalysts are synthesized by the modified Adams method changing the pore size distribution by the introduction of silica nanosphere (SNP) templates during the preparation. The specific surface areas of RuO_2 catalysts exceeded more than 150 m^2/g by using the $NaNO_3$ oxidant regardless of the SNP. The activity toward the OER of the catalysts is improved by the introduction of mesopore or macropore using the SNP templates (12, 120 nm). Among the catalysts, the macroporous RuO_2 catalyst showed the smallest overpotential which indicates that the meso- and macropores are efficient for OER in increasing active sites and bubble detachments.