Towards a Synthesis of Resorcinol-Formaldehyde Aerogel Microparticles

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Resorcinol-Formaldehyde (RF) aerogels are an important class of organic aerogels, which can be converted to carbon materials with remarkable properties. Carbon aerogels find applications in electrodes, batteries, foundries, adsorbents, etc. In foundry technology, aerogels can be used as binders and additives for sand cores and molds for the casting process. In the past, aerogel granulates were used as an additive in foundry sands to reduce casting defects by avoiding metal penetration and core collapse. The surface smoothness of the casting is improved and the emission of casting gas can be reduced. Traditionally, RF monoliths are prepared by aqueous poly-condensation of reactants under alkaline conditions, drying and further grinding into particles. Due to their poor mechanical performance, grinding of monoliths into specific size granules is not an easy task. Thus grinded particles have a broad particle size distribution and irregular shape. Hence, an alternative approach is required to produce RF microparticles, preferably a process of simple fabrication, reduced process time, lower equipment costs and easy handling. Emulsion-gelation method is an important technique to produce larger quantities of aerogel microparticles in a robust and controlled way. Here, we report the preparation of RF aerogel microparticles by emulsion-gelation method. The aqueous RF sol was prepared by mixing resorcinol, formaldehyde, H_2O and Na_2CO_3 under stirring at room temperature. RF sol was slowly added to the rapeseed oil phase under stirring at 60 °C. After 3h, the suspension containing spheres was kept at 60 °C in an oven for curing. The cured spheres were washed and the solvent was exchanged for further drying using supercritical and ambient methods. The physical and chemical properties of the dried RF particles were analyzed using FT-IR, N_2 adsorption isotherms, gas pycnometry, TGA and SEM. RF particles with surface area of 284 m^2/g, pore volume of 0.88 cm^3/g, pore diameter of 11.1 nm and average particle diameter of 200 µm were produced.

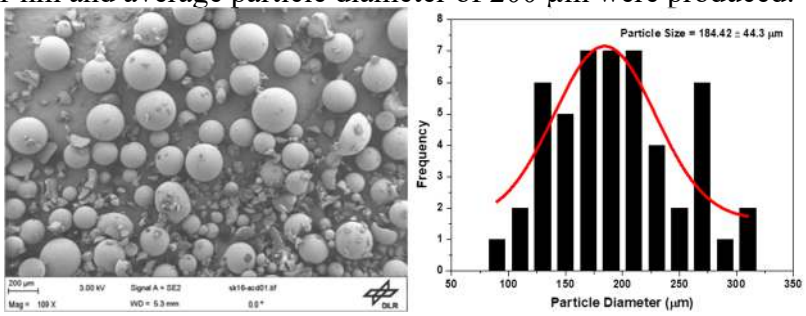

Figure: SEM image of the RF microparticles dried using SCD and its size distribution curve.

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