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Rare earth chalcogels $NaLnSnS_4$ (Ln=Y, Gd, Tb) for selective adsorption of volatile hydrocarbons and gases

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The synthesis and characterization of the rare earth chalcogenide aerogels NaYSnS4, NaGdSnS4 and NaTbSnS4 is reported. Rare earth metal ions like Y^{3+}, Gd^{3+} and Tb^{3+} react with the chalcogenide clusters $[SnS_4]^{4-}$ in aqueous formamide solution forming extended polymeric networks by gelation. Aerogels obtained after supercritical drying have BET surface areas of 649 m^2/g ($NaYSnS_4$), 479 m^2/g ($NaGdSnS_4$) and 354 m^2/g ($NaTbSnS_4$). Electron microscopy and physisorption studies revealed that the new materials have pores in the macro (above 50 nm), meso (2-50 nm) and micro (below 2 nm) regions. These aerogels show higher adsorption of toluene vapor over cyclohexane vapor and CO_2 over CH_4 or H_2. The notable adsorption capacity for toluene ($NaYSnS_4$: 6.90 mmol/g), ($NaGdSnS_4$: 12.36 mmol/g) and ($NaTbSnS_4$: 9.76 mmol/g) and high selectivity for gases $NaYSnS_4$ (CO_2/H_2: 155 and CO_2/CH_4: 37), $NaGdSnS_4$ (CO_2/H_2: 172 and CO_2/CH_4: 50) and $NaTbSnS_4$ (CO_2/H_2: 75 and CO_2/CH_4: 28) indicate potential future use of chalcogels in absorption-based gas or hydrocarbon separation processes.

Characterization and properties of the NaYSnS4 gel. (a) Nitrogen isotherm, (b) Pore–size distribution plot calculated by the BJH method from the adsorption isotherm, (c) Adsorption-desorption isotherms of toluene and cyclohexane observed at room temperature in (a) $NaYSnS_4$, (d) Selectivity of CO_2 over H_2 and CO_2 over CH_4 in $NaYSnS_4$.

Biography

Fatimah Edhaim is pursuing her PhD at King Abdullah University of Science and Technology. She completed her Master's Degree. In laboratory, she synthesizes new porous materials which have promising applications in gas and hydrocarbon separation. She participated in a number of international conferences where her work was selected for oral and poster presentations and where she received very good feedback from colleagues. At present, she is publishing her papers with results for at least three research articles. She is an expert user of many analytical techniques including XRD, XRF, SEM, EDX, TGA, TDA, ICP, CPD, FTIR, UV and physical adsorption instrumentation.

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