

Rare earth Chalcogels NaLnSnS₄ (Ln= Y, Gd, Tb) for Selective Adsorption of Volatile Hydrocarbons and Gases

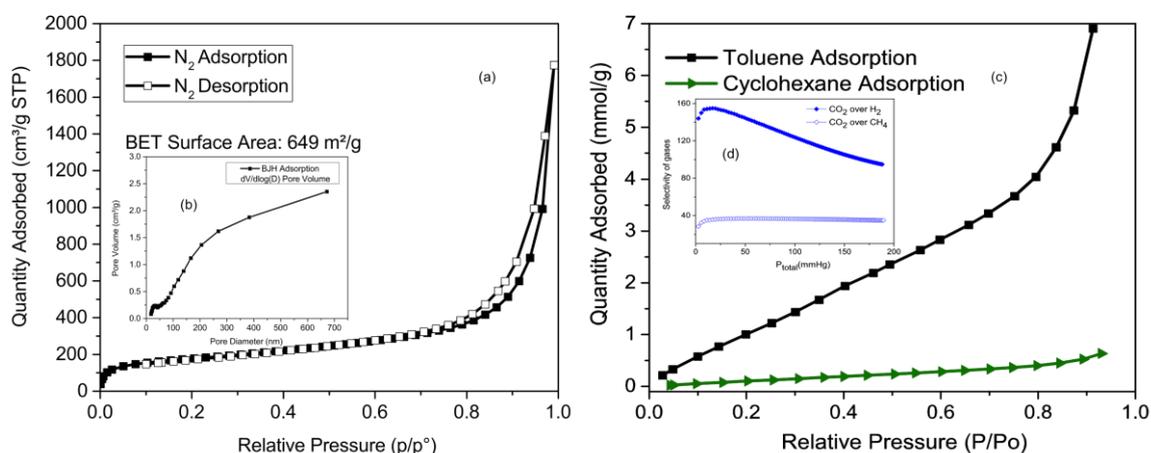
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Abstract (300 word limit)

The synthesis and characterization of the rare earth chalcogenide aerogels NaYSnS₄, NaGdSnS₄ and NaTbSnS₄ is reported. Rare earth metal ions like Y³⁺, Gd³⁺ and Tb³⁺ react with the chalcogenide clusters [SnS₄]⁴⁻ in aqueous formamide solution forming extended polymeric networks by gelation. Aerogels obtained after supercritical drying have BET surface areas of 649 m²/g (NaYSnS₄), 479 m²/g (NaGdSnS₄) and 354 m²/g (NaTbSnS₄). 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 CO₂ over CH₄ or H₂. The notable adsorption capacity for toluene (NaYSnS₄: 6.90 mmol/g), (NaGdSnS₄: 12.36 mmol/g) and (NaTbSnS₄: 9.76 mmol/g) and high selectivity for gases NaYSnS₄ (CO₂/H₂: 155 and CO₂/CH₄: 37), NaGdSnS₄ (CO₂/H₂: 172 and CO₂/CH₄: 50) and NaTbSnS₄ (CO₂/H₂: 75 and CO₂/CH₄: 28) indicate potential future use of chalcogels in absorption-based gas or hydrocarbon separation processes.

Image



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) NaYSnS₄, (d) Selectivity of CO₂ over H₂ and CO₂ over CH₄ in NaYSnS₄



Biography (150 word limit)

Ms Edhaim has been enrolled as a PhD student in the KAUST chemistry program since the beginning of 2013. She has completed the master portion with 36 credits. Since she joined KAUST, she adapted quickly to the academic working environment, progressed very well and has expanded her technical skills.

In the laboratory Ms Edhaim 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 Ms Edhaim is publishing her papers with results for at least three research articles.

Ms Edhaim is an expert user of many analytical techniques incl. XRD, XRF, SEM, EDX, TGA, TDA, ICP, CPD, FTIR, UV and physical adsorption instrumentation.

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Recent Publications (minimum 5)

1. Edhaim, F.; Rothenberger, A. (2016) Preferential Adsorption of Volatile Hydrocarbons on High Surface Area Chalcogels KMBiTe₃ (M = Cr, Zn, Fe), Submitted
2. Edhaim, F.; Rothenberger, A. (2016) Rare earth Chalcogels NaLnSnS₄ (Ln= Y, Gd, Tb) for Selective Adsorption of Volatile Hydrocarbons and Gases, Submitted
3. Isik, M.; Zulfiqar, S.; Edhaim, F.; Ruiperez, F.; Rothenberger, A.; Mecerreyes, D. (2016) Sustainable Poly(Ionic Liquids) for CO₂ Capture Based on Deep Eutectic Monomers. ACS Sustainable Chemistry & Engineering
4. Edhaim, F.; Rothenberger, A. (2015) Adsorption of Volatile Hydrocarbons and Gases in Metal Polysulfide Chalcogels. PPM2015
5. Shouwen, S; Zaidi, S; Mutairi, B; Shehry, A; Sitepu, H; Hamoud, S; Khaldi, F; Edhaim, F (2012) Quantitative XRD bulk and clay mineralogical determination of paleosol sections of Unayzah and Basal Khuff clastics in Saudi Arabia. Powder Diffraction

