Research Work Title

The Synthesis, Chemical Properties and Application of Unique Compounds Containing Rare-Earth Elements, Lithium and Boron

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Field | Mineral Chemistry

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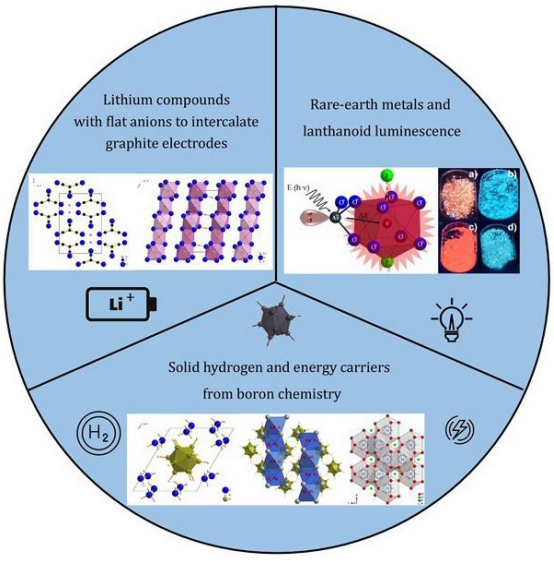
Abstract

Professor Thomas Schleid has successfully synthesized and characterized a total of 1035 new crystalline phases, consisting of 800 lanthanide, 100 boron, and 55 lithium compounds. These new compounds have a wide range of applications, including their use as ion conductors in batteries (such as sulfurized polypropylene as a cost-effective cathode material for high-capacity lithium-sulfur batteries and lithium thiocyanate), luminescent materials (like thallium hydroborate and Europium (II) Halide Oxoborates), and in hydrogen storage (such as ammonium and hydrazinium closo-hydroborates).

Part 1: Li+-cation conductors: Promising candidates: a) Lithium salts with soft complex anions, e.g. Li[CN], Li[OCN], Li[SCN], Li[N(CN)2] and Li[C(CN)3], all cigar-shaped or flat planar; b) Argyrodite-inspired ortho-thiophosphates(V) with participation of trivalent rare-earth metals, e.g. Li3RE[PS4]2, Li4RE[PS4]2Cl, Li6RE3[PS4]5 and Li9RE2[PS4]5.

Part 2: Heavy-metal phosphors: Tl3Cl[B12H12]: Blue Tl+ lone-pair luminescence, EuHCl and Eu5H2O2I4: Ligand-dependent Eu2+ broad-band luminescence, almost ligand-independent Ln3+ line-luminescence (Ln = Eu or Tb) in bulk or doped samples containing hard fluoride and oxoanions, e.g. YF[SeO3], Gd3F[SeO3]4, Y5F3[AsO3]4, La2F2[As2O5] with lone-pair antennae or YF[MoO4], YF[WO4] and YFMo2O7 with charge-transfer antennae.

Part 3: Solid-state hydrogen carriers: Ammonium and hydrazinium salts with hydro-closo-borate cage anions offer B–Hδ–···Hδ+–N dihydrogen bonds as preformed pathways for the irreversible release of elemental hydrogen (H2): (NH4)2[BnHn], (NH4)3X[BnHn], (N2H5)2[BnHn] and (N2H5)2[BnHn] · 2 N2H4 with X = Cl – I and n = 10 and 12.



Professor Thomas Schleid has been an active member of multiple professional organizations, such as the German Crystallographic Association (DGK) and the German Chemical Society (GDCh) where he served as the chairman of the Crystal-Chemistry Section from 2010 to 2015 and the Chemical Education Section from 2012 to 2016. Currently, Professor Schleid is serving as the president for the German Crystallographic Association, a position he has held since 2021.