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Topological Insulators from a Chemist's Perspective

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Topological insulators are formed out of heavy atoms and host special surface or edge states. The electronic structure is characterized by a Dirac cone within a bulk band gap (see Figure 1) that is generated by strong relativistic effects. A chemist′s perspective in terms of bonds, bands, symmetry, and nuclear charge is provided.

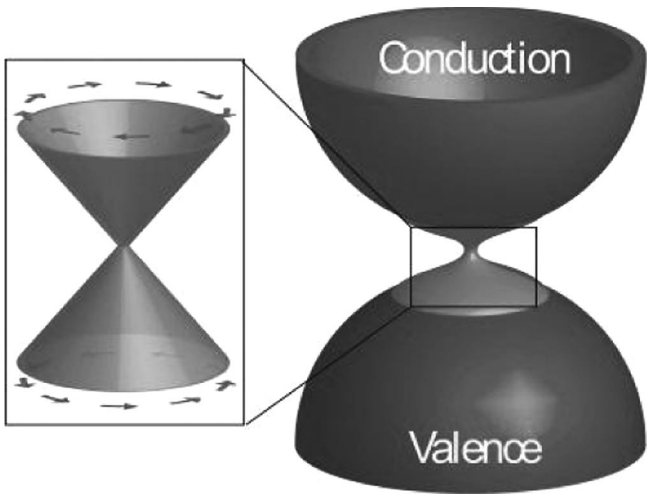

Figure 1. Generic band structure of a topological insulator. A Dirac cone with a chiral spin structure exists within the bulk band gap.[1]

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Synthesis of $PbBiO_2Br$ Nanoparticles

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$PbBiO_2Br$ is a promising substitute for the UV light active photocatalyst TiO_2. With its band gap of about 500 nm[1], organic synthesis can be photo-catalyzed using visible light.[2] Bulk $PbBiO_2Br$ prepared via solid state chemistry showed already good photocatalytic results using visible light.[3] Nanoparticles of this material are expected to increase the catalytic activity because of a significantly increased specific surface area. $PbBiO_2Br$ nanoparticles were prepared by dispersing $Pb(OAc)_2{\cdot}3H_2O$, $Bi_5O(NO_3)_4(OH)_9$ and NaBr in ethylene glycol (*EG*) or H_2O, resp. After heating at various temperatures, white dispersions turned yellow. Dry powders were analyzed by UV-Vis absorption, BET absorption, XRD and TEM imaging. Particles prepared in *EG* showed large specific surface areas, blue shift of light absorption and broad reflections in XRD patterns. Particles prepared in aqueous dispersions are larger in size. But here also larger specific surface areas, broad reflections in XRD and a blue shift of light absorption is observed. TEM images of these powders showed aggregates of flake-like particles. With this route, it was possible to synthesize the first quaternary semiconductor nanomaterial.

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