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Spinels Renaissance: The past, present, and future of those ubiquitous minerals and materials

The systematics of the spinel-type minerals: An overview†

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Abstract

Compounds with a spinel-type structure include mineral species with the general formula $AB_2\varphi_4$, where φ can be O^{2-}, S^{2-}, or Se^{2-}. Space group symmetry is $Fd\bar{3}m$, even if lower symmetries are reported owing to the off-center displacement of metal ions. In oxide spinels ($\varphi = O^{2-}$), *A* and *B* cations can be divalent and trivalent ("2-3 spinels") or, more rarely, tetravalent and divalent ("4-2 spinels"). From a chemical point of view, oxide spinels belong to the chemical classes of oxides, germanates, and silicates. Up to now, 24 mineral species have been approved: ahrensite, brunogeierite, chromite, cochromite, coulsonite, cuprospinel, filipstadite, franklinite, gahnite, galaxite, hercynite, jacobsite, magnesiochromite, magnesiocoulsonite, magnesioferrite, magnetite, manganochromite, qandilite, ringwoodite, spinel, trevorite, ülvospinel, vuorelainenite, and zincochromite. Sulfospinels ($\varphi = S^{2-}$) and selenospinels ($\varphi = Se^{2-}$) are isostructural with oxide spinels. Twenty-one different mineral species have been approved so far; of them, three are selenospinels (bornhardtite, trüstedtite, and tyrrellite), whereas 18 are sulfospinels: cadmoindite, carrollite, cuproiridsite, cuprokalininite, cuprorhodsite, daubréelite, ferrorhodsite, fletcherite, florensovite, greigite, indite, kalininite, linnaeite, malanite, polydymite, siegenite, violarite, and xingzhongite. The known mineral species with spinel-type structure are briefly reviewed, indicating for each of them the type locality, the origin of the name, and a few more miscellaneous data. This review aims at giving the state-of-the-art about the currently valid mineral species, considering the outstanding importance that these compounds cover in a wide range of scientific disciplines.

Keywords: Spinel, oxide spinel, sulfospinel, selenospinel