

Color effects of Cu nanoparticles in Cu-bearing plagioclase feldspars

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ABSTRACT

The optical properties (scattering, absorption, and extinction) of spheroidal Cu particles embedded in intermediate plagioclase feldspar are computed for various sizes and shapes using the Mie theory and T-matrix method. The observed color for Cu-bearing plagioclase, as a function of particle size and shape, is also calculated from the computed extinction spectra. The colors and pleochroism observed in natural and treated Cu-bearing plagioclase can be explained from the computational results. The enigmatic green colors in some precious Oregon sunstones result from red light being scattered away by Cu nanoparticles of certain sizes. The UV-VIS spectra are collected on Cu-bearing plagioclase samples for comparison with the computational results, which are shown to match the optical observations. The results from this work may be used to quantify the concentration of colloidal Cu in plagioclase or glass with a similar refractive index. Particle sizes and shapes can also be characterized using extinction and scattering spectra, which can be collected with different optical configurations. New materials with special color effects and optical characteristics may be designed and engineered by applying the unusual properties of metal colloids.

Keywords: Oregon sunstone, Cu nanoparticle, pleochroism, absorption, scattering, extinction