

## Sulfuric Acid on Europa's Surface and the Radiolytic Sulfur Cycle

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Galileo infrared spectra of Europa's surface show distorted water bands that have been attributed to hydrated evaporite salts (McCord et al., *J. Geophys. Res.* 104, 11827, 1999) or to the scattering properties of ice (Dalton and Clark, *Bull. Am. Astron. Soc.* 30, 1081, 1998). Using new laboratory spectra, we show that hydrated sulfuric acid can explain Europa's spectra and further show that this species is product of radiolysis. Sulfuric acid on Europa occurs as the radiolytically stable octahydrate and hemihexahydrate and is a major surface component, along with water ice. The sulfuric acid concentration spatially correlates with Europa's visually dark material, which we identify as radiolytically altered sulfur polymers. Radiolysis by incident jovian plasma continuously cycles sulfur between three chemical reservoirs: sulfuric acid, polymerized sulfur, and sulfur dioxide, with the acid being about 50 times more abundant than the other forms because of the stability of the sulfate anion under irradiation. The original source of sulfur may be incident iogenic sulfur ions or endogenic sulfur compounds that are altered by radiolysis. Geological processes can bury and redistribute the sulfurous material, producing a sulfur-rich crust and a non-uniform surface distribution. The low melting point of sulfuric acid and its ability to supercool may facilitate geological processes. Europa's magnetic response may be influenced by the electrical conductivity of sulfuric acid.