Radiation-induced chemical reactions for ice-silicate mixture systems

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There are many ice-silicate mixture systems in interstellar mediumthe and on the Earth. An interstellar dust grain contains a core of silicate and a mantle of volatile ices, and aggregation of such dusts creates cometary nucleus. Surfaces of icy bodies, such as Jovian satellites Europa, Callisto and Ganymede may include silicate dusts. Glaciers and ice sheets on the Earth also contain silicate dusts. Radiation induced chemical reactions must occur in these systems by cosmic rays, solar UV, solar protons and radiation from radioactive elements.

Radiation damages formed in silicate have been studied by electron spin resonance (ESR), thermoluminescence (TL) and optically stimulated luminescence (OSL) to date archeological and geological samples like quartz and feldspar. Radiation effects for icy materials, such as solid H2O, D2O, CO2 and SO2 have been studied with ESR, TL and OSL for the dating using ice samples on icy bodies in future planetary surveys. However radiation effects for ice-silicate mixture systems have been scarcelystudied.

The purpose of this study is to reveal formation processes, thermal stabilities and reactions on radiation-induced species formed in ice and silicate interface. The results must make progress in studies about chemical evolutions in icy bodies. The radiation-induced species might tell us when the dust lied in the ice.

ESR, TL and OSL measurements were performed for gamma-irradiated quartz powdered by ball mill, and ices frozen from the quartz blended water and pure water. The authors will present radiation-induced free radicals in the samples, thermal stabilities of the radicals, the results of TL and OSL.