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Far-infrared spectra of synthetic dioctahedral muscovite and muscovite–tobelite series micas: Characterization and assignment of the interlayer $I–O_{inner}$ and $I–O_{outer}$ stretching bands

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ABSTRACT

Far-infrared spectroscopy and X-ray powder diffraction Rietveld structure refinement for the hydrothermal synthetic muscovite series, (a) $KAl_3(Si_{3-y}Ge_y)O_{10}(OH,OD)_2$, (b) $KGa_3(Si_{3-y}Ge_y)O_{10}(OH,OD)_2$, and (c) $K(Al_{3-x}Ga_x)Ge_3O_{10}(OH,OD)_2$, where x = 0.0–3.0, y = 0.0–3.0, and the muscovite–tobelite series, (d) $[K_{1-A}(NH_4,ND_4)_A]Al_3Si_3O_{10}(OH,OD)_2$, where A = 0.0–1.0, indicate that there is a complete solid-solution in each series. In the 200–50 cm^{-1} far-infrared region, four kinds of bands are observed: two bands due to octahedral deformation coupled with OH deformational vibrations between 240 and 130 cm^{-1}, an in-plane tetrahedral torsional band between 175 and 130 cm^{-1}, an interlayer $I–O_{inner}$ stretching band, and an $I–O_{outer}$ stretching band. The weak and broad 140 cm^{-1} band is assigned to $K–O_{inner}$ stretching and the strong broad 110 cm^{-1} band to $K–O_{outer}$ stretching in muscovite. The broad 175 cm^{-1} band is $(NH_4/ND_4)–O_{inner}$ stretching and the 140 cm^{-1} broad strong band is $(NH_4/ND_4)–O_{outer}$ stretching in tobelite. With increasing Ga→Al substitution, the $I–O_{inner}$ and $I–O_{outer}$ stretching bands shift to lower frequency, while with increasing Ge→Si substitution, the $I–O_{inner}$ stretching band shifts to higher frequency; the $I–O_{outer}$ stretching bands do not change as a function of composition.

Keywords: Far-infrared spectra, muscovite, tobelite, dioctahedral mica