Spin crossover in ferropericlase by nuclear resonant spectroscopy

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Iron-bearing phases of the lower mantle like (Fe.Mg)O ferropericlase and (Fe,Mg)SiO_3 perovskite have recently been studied to evaluate the presence of pressure-dependent crossovers between the high-spin and the low-spin state of iron. Such a crossover was clearly observed in ferropericlase using x-ray emission spectroscopy [1,2], conventional Mössbauer spectroscopy [3], and synchrotron Mössbauer spectroscopy [4]. In the case of silicate perovskite, the electronic state of the iron has been studied with x-ray emission spectroscopy [5,6] and synchrotron Mössbauer spectroscopy [7] but the situation remains unclear.

In this contribution, we discuss the application of nuclear resonant spectroscopy to the study of the spin crossover in iron-bearing minerals. In particular, we will use nuclear resonant inelastic x-ray scattering to probe the vibrational density of states and synchrotron Mössbauer spectroscopy to determine of valence and spin state. We will discuss the effects of the spin crossover in ferropericlase on the vibrational density of states. We will also briefly address the potential effects of high temperatures of the spin crossover in the framework of a recently suggested thermal population model [8].

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