Measurement of the Electric Field Gradient at $^{181}$Ta in Zr-SiO$_4$ and HfSiO$_4$ using Perturbed Angular Correlation Spectroscopy

HERBERT JAEGGER, Miami University, SEAN MCBRIDE, University of Nebraska-Lincoln — Perturbed angular correlation spectroscopy (PAC) is a nuclear technique often used to probe the hyperfine interaction of a nuclear moment with extra-nuclear fields. For example the electric field gradient (EFG) at a $^{181}$Ta probe nucleus in zircon (ZrSiO$_4$) depends on the arrangement of the Zr, Si, and O-atoms and is very sensitive to structural rearrangements. Our PAC experiments with zircon show that a very subtle rearrangement of Si-atoms within the unit cell leads to a change in the temperature dependence of the EFG. We are currently performing a series of PAC experiments on the isostructural hafnon (HfSiO$_4$). Preliminary results show no evidence of a similar structural rearrangement. In addition to the EFG, we also measure the anisotropy of the $\gamma\gamma$-cascade emitted during the decay of a $^{181}$Ta nucleus. The measured anisotropy depends somewhat on the geometry of the sample and detector arrangement. However, with a given nucleus and a fixed geometry one would not expect a substantial change in the anisotropy during a series of measurements, say as a function of temperature. Yet our PAC spectra of zircon show a consistent decrease of the anisotropy in the temperature range between 650 and 800 °C. Preliminary PAC spectra of hafnon show no change of the anisotropy. Reasons for this apparent loss in anisotropy will be discussed.