

Nuclear Resonant Inelastic X-ray Scattering Studies of Isotope Fractionation

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Nuclear Resonant Inelastic X-ray Scattering (NRIXS) provides a new experimental method to determine the equilibrium stable isotope fractionation factors, which has been an extensive and important field of study in geo- and cosmo-chemistry. Over seventy years ago, Bigeleisen and Goeppert-Mayer proposed a theory relating isotope fractionation factor to its kinetic energy. One of the atomic dynamics quantities can be derived from NRIXS spectrum is isotope specific kinetic energy, thus it provides a direct and straight forward application of Bigeleisen and Goeppert-Mayer formalism. We have extended the formalism to use mean atomic force constant which is another quantity that can be derived from NRIXS experiments. This new method to study isotope fractionation is non destructive and can be applied under various and extreme sample conditions, thus provides fractionation information for much broader geo- and cosmo-chemistry research. With enhanced X-ray capabilities at the new APS-U light source, we expect to broaden the scope of this method in isotope fractionation research. We will present the results from NRIXS studies of minerals that contain iron, tin, europium and dysprosium.