Ion Track Analysis in Swift Heavy Ion Irradiated KTP

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The morphology properties of swift heavy ion tracks in $KTiOPO_4$ (KTP) were studied with small angle x-ray scattering (SAXS), transmission electron microscopy (TEM), and atomic force microscopy (AFM) methods. KTP samples in both x-cut and z-cut orientations were irradiated by 185MeV Au ions with ion fluences of 1×10^{10} and 1×10^{11} ions/cm^2. A hard-cylinder morphology of ion track is indicated from the SAXS data, with the total track radius of ~ 6nm, and the density contrast between the ion track and surrounding matrix of around 1±0.5% for all irradiation conditions. TEM images in both cross-section and plan-view show an amorphous ion track and crystalline surrounding, and the diameter of tracks is ~ 13nm, consistent with the SAXS analysis. Small-sized hillocks covering the sample surface were detected with AFM, and the number increases with the increasing ion fluence. These raised hillocks on the sample surface indicate the amorphous structure inside the tracks has lower density than the unirradiated material.

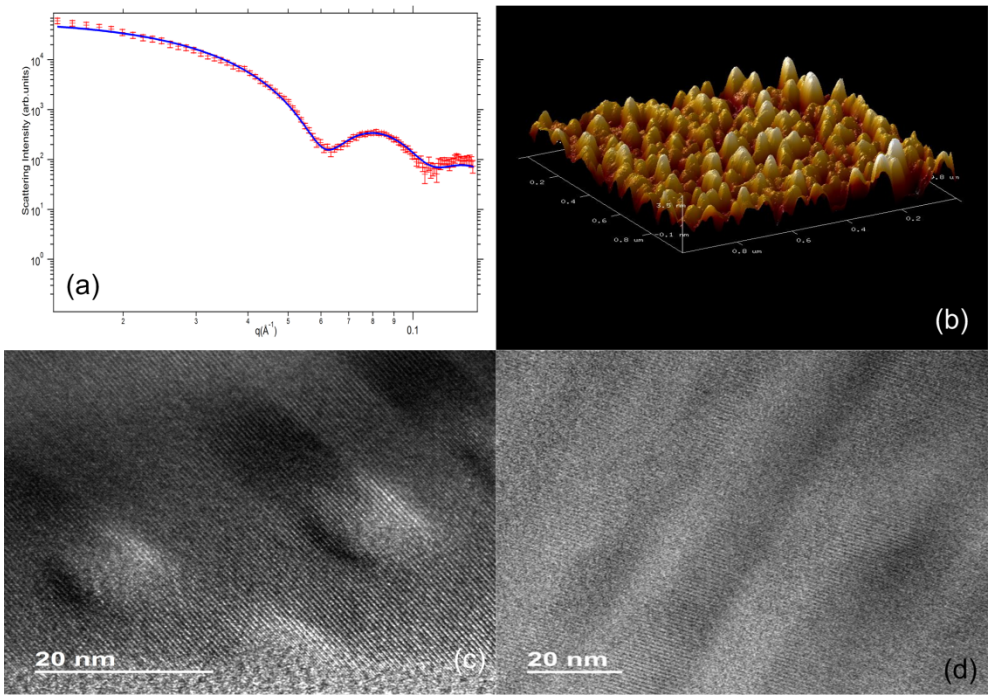

Figure (a) SAXS spectra of ion tracks in z-cut KTP with ion fluence of 1×10^{10} ions/cm^2 as a function of the scattering vector q, and the solid line is the fits to the theoretical model.
(b), (c) and (d) are the AFM micrograph of sample surface in three-dimension, and TEM image in plan-view and cross-section, respectively for z-cut KTP with 1×10^{10} ions/cm^2.