Ion Track Analysis in Swift Heavy Ion Irradiated KTP

Yu-Jie Ma\textsuperscript{1,2}, Felipe Kremer\textsuperscript{1}, Daniel Schauries\textsuperscript{1}, Thomas Bierschenk\textsuperscript{1}, P. Kluth\textsuperscript{1}, Fei Lu\textsuperscript{2} and M.C. Ridgway\textsuperscript{1}

\textsuperscript{1} Department of Electronic Materials Engineering, Research School of Physics and Engineering, The Australian National University, ACT 0200, Australia
\textsuperscript{2} School of Information Science and Engineering, Shandong University, Jinan, Shandong 250100, China

The morphology properties of swift heavy ion tracks in KTiOPO\textsubscript{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 $1\times10^{10}$ and $1\times10^{11}$ ions/cm\textsuperscript{2}. A hard-cylinder morphology of ion track is indicated from the SAXS data, with the total track radius of $\sim 6$nm, and the density contrast between the ion track and surrounding matrix of around $1\pm0.5\%$ 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 $\sim 13$nm, 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 $1\times10^{10}$ ions/cm\textsuperscript{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 $1\times10^{10}$ ions/cm\textsuperscript{2}. 