IRRADIATION OF ANORTHITE BY IRON IONS-A SIMULATION OF THE SOLAR WIND ORIGIN OF NANOPHASE IRON IN LUNAR SOIL.

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Introduction: Previous studies revealed that nanophase iron particles are rather common in the surface layer of mature lunar soil grains [1],[2],[3]. Interpretations for the origin of those nanophase iron particles include solar wind sputtering, micrometeorites bombardment and vaporization [4]. Here, we present a simulant study of the origin of nanophase iron particles that implanted into the lunar soil particles by solar wind, with a goal to better understand the processes that led to the formation of nanophase iron particles.

Results: Natural anorthite specimen (An_{98}) was selected and crushed in a planetary ball mill. The powder was implanted vertically by 56keV Fe^{+} ion beam and the final dose was $1.0\times10^{15}cm^{-2}$. Ultrathin sections of implanted grains were eventually prepared using an ultramicrotome. These sections were analyzed utilizing a 200 kV, JEOL 2100 transmission electron microscope (TEM) housed at the Tsinghua University.

Random distributions of dark particles less than ten nanometers were discovered in the implanted anorthite grain. In order to identify the characteristics of those particles, focal image series were taken to make sure the microstructure of nanophase iron particles were accurately displayed. Diffraction characteristics were subsequently obtained by Fourier transformation of the suite of HR-TEM image. Crystal planes of those dark nano size particles have been identified through comparison of the observed distance to the crystal plane data for iron as well as iron oxides in X-ray diffraction database. Iron, ferroferric oxide and ferric oxide were identified from those dark nanophase particles.

Discussion: According to the result, nanophase iron particles can be produced in pure anorthite by the implantation of iron ions. There are two processes for the formation of iron oxides. The first is the combination of implanted iron ions with oxygen in anorthite [5]. The second is the exposure of implanted specimens to the atmosphere during the sample preparation, especially the preparation of ultrathin sections.

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