

Application of a pulsed neutron transmission method to a cultural heritage study

Wednesday, 11 September 2013 11:30 (20 minutes)

A pulsed neutron transmission imaging method is a unique method which can give spatial dependent information on physical parameters of materials, such as crystallographic characteristics, elements, magnetic field, and so on. These data are obtained by analyzing the transmission spectra dependent on the neutron wavelength observed at each pixel of a 2-D position sensitive detector. We succeeded in obtaining the crystallite size, preferred orientation, lattice spacing, and element information of some metal materials. We have considered this method would be useful for studying the cultural heritage materials. As the first test samples we have studied Japanese swords. The Japanese swords are well known for their special characteristics. We performed experiments to reveal what kinds of information could be obtained by exploiting pulsed neutron transmission methods. We examined four Japanese swords. Three of them are fragments of swords and one is a full size. Two fragments were produced in Okayama prefecture in 16 and 17 century, and the third one in Kanagawa prefecture. We used a GEM detector for the fragments and a MCP detector for the full size.

Summary

From the fragment sample we obtained crystallite size information and preferred orientation information. The crystallite size of the swords in Okayama is almost the same, about 3.0 μ m, and that in Kanagawa is about 3.7 μ m. Degree of the anisotropy is similar for the old Okayama fragment and the Kanagawa one. The new Okayama one is rather isotropic. We obtained the lattice spacing distributions from edge to back for the full size sword. There are clear differences between middle position and edge position of the sword. Martensitic phase was observed at the edge position and it disappears in the tang (nakago) area. These results indicate that the pulsed neutron transmission method is one of useful non-destructive inspection methods for cultural heritages.

This work was supported by (JSPS) KAKENHI (23226018).

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Session Classification: Neutron Imaging IV

Track Classification: NINMACH