Nuclear Materials Science

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【Staff Members】

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【Research Activities】

Efforts are continued to improve properties of functional materials by radiation effects. It is found that the proton conductivity of some polymers are substantially enhanced by radiation effects caused by gamma-rays, neutrons and energetic ions. (**Ref.*1***) Experimental results show that some part of the sulfonic bases, which compose conducting passes for protons, is passivated by some positively charged impurities. Radiation effects are considered to release the impurities from the sulfonic bases, with the results that many sulfonic bases could contribute to forming conducting passes for the protons. The irradiation procedures are submitted for a patent to improve the proton conductivity of the polymer.

An optical system for dosimetries is developed, with radiation resistant optical fibers and radioluminescence materials. Especially, radioluminescence from fused silica themselves are extensively studies. (**Ref.*2***) and effects of 14MeV neutrons on optical fibers are studied. (**Ref.*3***). A patent of optical dosimetry system utilizing optical fibers and radioluminescence materials and a patent of radioluminescence materials working at elevated temperatures are submitted.

Possibility of developing a system in which energy of gamma-rays are directly converted into electricity is pursued, with some ceramics and metallic electrodes.(**Ref.*4***) Surface recombination of low energy electrons which are generated through the photo-electronic process is found to be unimportant for the phenomenon called radiation induced electro-motive force.

Radiation effects on ceramics and some components for nuclear fusion plasma diagnostics are studied through an international collaboration and results are contributed to detailed designs of the ITER diagnostics.(**Ref.*5***)

1. Adachi T., Nagata S., Ohtsu N., Tsuchiya B., Toh. K, Morishita N., Yamauchi M., Nishitani T., Shikama T.,
Effects of gamma-ray neutron irradiation on electrical characteristics of proton-conducting polymer electrolyte membranes
J. Nucl. Mater., 307-311 (2004) 1499-1502

2. Nagata S., Yamamoto S., Toh K., Tsuchiya B., Ohtsu N., Shikama T.,
Luminescence in SiO_2 induced by MeV energy proton irradiation
J. Nucl. Mater., 307-311 (2004) 1507-1510

3. Toh K., Shikama T., Nagata S., Tsuchiya B., Suzuki T., Okamoto K., Shamoto N., Yamauchi M., Nishitani T.,
Optical characteristics of aluminum coated fused silica core fibers under 14MeV neutron irradiation
J. Nucl. Mater., 307-311 (2004) 1495-1498

4. Tsuchiya B., Shikama T., Nagata S., Toh K., Narui M., Yamazaki M.,
Electrical conductivities of dense and porous alumina under reactor irradiation
J. Nucl. Mater., 307-311 (2004) 1511-1514

5. Decreton M., Shikama T., Hodgson E.,
Performance of functional materials and components in a fusion reactor: the issues of radiation effects in ceramics and glass materials for diagnostics
J. Nucl. Mater., 307-311 (2004) 125-1321.

【Plan】

1. Effects of irradiation on hydration of the protonic-conductive polymer and on behaviors of hydrogen in the polymer will be studied systematically through optical spectroscopy in the wavelength range of the visible to the infrared. Improvement of proton conduction in irradiated polymers will be demonstrated in an actual polymer electrolyte cell, which will be realized through interdisciplinary collaboration with outer research groups.
2. Efforts will be continued to develop radioluminescence materials and radiation resistant optical fibers. Developed optical dosimetry system will be applied to actual nuclear systems, such as HTTR, JOYO, nuclear fusion systems, etc., under collaboration with concerned organizations.
3. Corresponding mechanisms for the radiation induced electromotive force (RIEMF) will be studied utilizing accelerators and fission reactors. A role of hydrogen in the RIEMF will be focused in in-situ studies of RIEMF in accelerators and reactors. The goal is to prove applicability of the RIEMF to direct conversion of radiation energy to electricity in a nuclear system.
4. Study of radiation effects in glassy metals will be started. Structural modification of glassy metals by radiation effects will be pursued, with accelerators for the modification of surface layers and with reactors for the bulk modifications and for the applicability of glassy metals in nuclear systems. A new irradiation rig is under development for systematic irradiation of candidate materials for nuclear application, through collaboration with JAERI and JNC.