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Gamma irradiation effect on optical and laser damage performance of KDP crystals

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KDP (KH2PO4) is a nonlinear transparent dielectric crystalline material used in various laser systems for harmonic generation. It has been used for inertial confinement fusion in the National Ignition Facility, USA. However, the physical and chemical properties of the KDP crystals may degrade under γ and neutron radiations. Therefore, it is important to understand the effects of radiations on the optical properties especially laser induced damage performance during subsequent laser irradiation.
In this work, the effect of Co60 gamma-ray irradiation on KDP crystal with the dose in a range from 1 kGy to 100 kGy is investigated using UV-Vis absorption, fluorescence, DC electrical conductivity, positron annihilation lifetime, and laser induced damage threshold (LIDT). A wide absorption band between 250 and 400 nm appears after γ-irradiation and its intensity increases with the increasing irradiation dose. The dc electrical conductivity of γ-irradiated KDP crystals increases with the increasing irradiation dose when the dose is less than 10 kGy while it remains constantly with the irradiation dose beyond 100 kGy. The increase of electrical conductivity is associated with the increase of proton defect concentration in the crystal and the related mechanism is discussed. The positron annihilation lifetime spectroscopy is also used to reveal the evolution of vacancy-type defects in KDP crystal. The decrease of LIDT and size of vacancy-type clusters with the increasing irradiation dose is also investigated.

Short Bio: Wanguo Zheng is the Project Leader of SG-III laser facility in China. He is also the Deputy Director of Research Center for Laser Fusion, China Academy of Engineering Physics. He received his PhD degree in Optical Engineering at Fudan University. In 2011, he was awarded The 14th Qiushi Outstanding Young Scientist of China Association for Science and Technology. His research interests focuses on optical materials and large-aperture optical components, laser engineering and high-power laser technology, and radiation effects of materials. He has published more than 100 scientific papers in international peer-reviewed journals.

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