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P2.197 Spinel-nitride based radiation tolerant optical materials

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Radiation induced lattice defects strongly affect functionality of optical components, which will play a substantial role in various diagnostic systems of future fusion reactors. It is widely recognized that spinel lattice of double oxides (e.g. MgAl2O4) demonstrates enhanced radiation tolerance. One can expect a higher radiation tolerance of single cation spinels because in this case accommodation of radiation induced defects by swapping the positions of cations between tetrahedral and octahedral sites does not change anything in the lattice. Such kind of compounds are spinel nitrides (M3N4, where M = Si, Ge, Sn) recently discovered by one of us [1]. These compounds appear to be highly efficient luminescence materials suitable for fabrication of the new generation of LEDs covering the entire spectral range of the visible light. In this work spinel nitride samples were synthesized by laser heating in a diamond anvil cell and also using a high-pressure multi-anvil method. Self-healing ability (recovery of radiation induced defect) of interphase boundaries are expected since they are working as sinks for interstitials and vacancies. Therefore, solid solutions of (SiGe)3N4 were investigated in this work as well. To get the data on the electronic band structure and structural defects energy- and time-resolved optical spectroscopy using synchrotron radiation sources and cathodoluminescence setups were used [2, 3]. Our results confirm the theoretical prediction that spinel nitrides can be considered as basic materials for very efficient light emitting diodes suitable for application in demanding conditions under mechanical, thermal and radiation stress.
[1] Zerr A. et al. 2006, Advanced Materials 18, 2933.
[2] Museur L. et al. 2016, Scientific Reports 6, 18523.
[3] Feldbach E. et al. 2016, Optical Materials 55, 164.

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