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ULTRAFAST LASER-INDUCED INSCRIPTION OF NANOGRATINGS IN ALKALI SILICATE GLASSES

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Nanogratings are birefringent nanoperiodical structures generated inside glasses by a series of femtosecond laser pulses at certain pulse energies under melting threshold. They attract much attention due to their birefringence which can be controlled by the writing femtosecond beam that provides applications for devices with patterned birefringence such as polarization converters and ultrastable multilevel data storage, whereas enhanced chemical activity of nanogratings is used for selective etching of microfluidic components. Nanogratings were first revealed and studied in silica glass and recently demonstrated in several multicomponent glasses but there is still poor information about mechanism of their inscription depending on glass composition. Recently, we have demonstrated an effect of laser-induced nanoperiodical redistribution of Na^+ cations accompanying nanograting inscription in sodium silicate glass by 10^6-10^7 pulses. Here, we report possibility of nanograting formation in a set of R_2O-Si_02 glasses (R = Li, Na, K). We show that nanogratings can be inscribed in alkali silicate glasses by the number of pulses below 10^4 (two orders of magnitude faster than demonstrated for sodium silicate glass earlier) only in the narrow pulse energy range, which is quite different from silica glass. Surprisingly, though nanograting formation is possible at higher pulse energy, it takes much more pulses than in optimal pulse energy range. This effect is presumably attributed to the laser-induced chemical shift towards to lower alkali content and higher melting point, which takes place under a large number of laser pulses and allows formation of a nanograting instead of melting at a given pulse energy. Micro- and nanoscale chemical redistribution opens an opportunity of precision control of physical and chemical properties of predetermined microregions in multicomponent glasses for applications in photonics and optofluidics.

Biography

Sergey Fedotov has completed his PhD from Mendeleev University of Chemical Technology of Russia. He is researcher in the International Centre of Laser Technology of Mendeleev University of Chemical Technology of Russia. He has published 8 papers in reputed journals.

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