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Opinion

GRIN Optics: Brief History and Prospects

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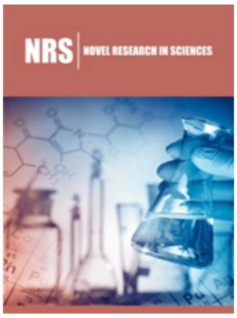

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Opinion

The birth year of gradient optics can be considered to be 1854, when an inhomogeneous medium known as Maxwell's "fish eye" was described. This was the first aberration-free device with a viewing angle close to 180 degrees. Over the next century and a half, interest in such optics waxed and waned several times. In particular, in the early 1980s, opticians once again turned to GRIN optics. Thus, in the USA, a group of researchers from the Institute of Optics at the University of Rochester, led by Duncan Moore, and in the USSR, a group of researchers led by the author of this article, made significant contributions to the theory, calculation methods, and correction of aberrations in optical systems with gradient index elements [1-4].

However, due to the lack of commercially available technologies at that time for obtaining a given refractive index distribution in optical materials with the required accuracy, interest in this topic quickly waned. Another surge in interest began about ten years ago, when IR system developers turned to GRIN optics. In this case, a real breakthrough was made jointly by specialists from the University of Rochester and the US Naval Research Laboratory.

Their research in the field of optical material science has led to the development of a special series of chalcogenide glasses of new grades that are transparent across a wide range of the Infrared (IR) spectrum, characterized by close values of thermal expansion coefficients, and with compatible viscosity profiles [5, 6]. An advantage of this glass series is the possibility of creating composite gradient materials using the lamination method, which involves mutual thermal diffusion of layers during the pressing of a multicomponent workpiece [7,8]. The number of chalcogenide glasses of new brands and the range of their characteristics make it possible to flexibly vary the distribution function of the refractive index of the molded material, thus expanding the possibility of correcting aberrations. This is confirmed, in particular, by works [9,10] containing results on simple thermal vision objectives with lenses made of gradient materials [9-11] established the possibility of developing new schematic solutions that can fully reveal the advantages of the used elemental base. It should be noted that chalcogenide glasses are materials that allow for precision pressing as a method of forming the surface optical elements [12]. This, together with the lamination method, opens up possibilities for creating a gradient material for lenses with optically optimized properties tailored to specific schematic solutions.

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