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Magnesium silicide is a promising material for optical sensors

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The article presents the result of the analysis, based on a literature review: the structure, optical and electronic properties of Mg_2Si in bulk and low-dimensional states. The properties of magnesium silicide in the low-dimensional state are compared with the properties of materials widely used in optoelectronics: GaAs, Si and Ge. Modern methods of forming Mg_2Si thin films are analyzed. It has been established from the literature data that, under conditions of thermodynamic equilibrium, the volumetric Mg_2Si has a face–centered cubic lattice, and the low-dimensional one has $2/3\sqrt{3}$-R30^o. Due to its optical and electronic properties, thin-film Mg_2Si is a promising material for optoelectronic devices. Thus, it has an incident light absorption coefficient, the maximum value of which, according to modern data, is 96 %. The photosensitivity range of Mg_2Si is in the range from 200 to 2100 nm. It was also determined from the review that this silicide is a non-bandgap semiconductor: the band gap of which is in the range from 0.6 to 0.8 eV. At the same time, direct transitions corresponding to energies from 0.83 to 2.17 eV are observed. The mobility of Mg_2Si electrons in the low − dimensional state ranges from 400 to 550 $cm^{2}\cdot V^{-1}\cdot s^{-1}$, and holes − from 65 to 70 $cm^{2}\cdot V^{-1}\cdot s^{-1}$. From the data considered, it was found out that the efficiency of photovoltaic conversion, for silicon–magnesium-based compounds with optimal thickness and impurity alloying, can reach 10–12 % for p–n and n–p (Si/Mg_2Si) and 22 % for p–n–p (Si/Mg_2Si/Si) structures. According to parameters such as the photosensitivity range and the band gap, the values of which are given above, Mg_2Si in the low-dimensional state exceeds GaAs, Si and Ge, and therefore can be considered a promising material for optoelectronics.

Keywords: thin films, magnesium silicide, silicon, optical sensors, structural analysis, optical properties, electronic properties, methods of formation.

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