

Inverse design of antireflection silicon-on-silicon coatings

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Designer gratings, also known as metagratings, can be tuned to perform various kinds of tasks, such as amplify deflection in a particular diffraction order, increase or decrease transmission and reflection [1]. A typical task for various kinds of coatings is to reduce reflection from a surface. Inspired by this, we set out to design a single-layer silicon metagrating as an antireflection cover for solar cells, itself made from silicon, which introduces high reflection of light (30-50%) from a flat interface, a significant inefficiency in the cells' ability to capture incident radiation [2]. To achieve desired low reflection (around 5% or less) for both polarizations, a range of incidence angles and a wide band from 400 to 1200 nm, a large space of unit cell designs of the periodic structure has to be explored. In this work, we apply an inverse design approach [3] to solve this task and generate patterns which demonstrate the required performance.

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2. Mascaretti L. et al. Designing metasurfaces for efficient solar energy conversion // ACS Photonics. –2023. –10. –№12. –P. 4079.
3. Jiang J., Fan J. A. Multiobjective and categorical global optimization of photonic structures based on ResNet generative neural networks // Nanophotonics. –2020. –10. –№1. –P. 361.

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