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Ultra-broadband near-perfect solar absorber in the visible and near-infrared region

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Increasing the absorption efficiency of solar radiation has great significance for the renewable energy applications, such as residential water heating, seawater desalination, wastewater treatment and solar thermophotovoltaic devices. Optical absorbers based on metamaterials have been widely investigated using a variety of structural designs. We propose and numerically investigate a novel ultrabroadband solar absorber by applying iron in a 2D simple metamaterial structure. The proposed structure can achieve the perfect absorption above 95% covering the wavelength range from 400 to 1500 nm. The average absorption reaches 97.8% over this wavelength range. The broadband perfect absorption is caused by the excitation of localized surface plasmon resonance and propagating surface plasmon resonance. We first propose and demonstrate that the iron is obviously beneficial to achieve impedance matching between the metamaterial structure and the free space over an ultra-broad frequency band in the visible and near infrared region, which play an extremely important role to generate an ultra-broadband perfect absorption. In order to further broaden the absorption band, we also demonstrate the perfect absorption exceeding 92% for the 400–2000 nm range by adding the number of metal-dielectric pairs and using both gold and iron simultaneously in the proposed structure. The average absorption of the improved absorber reaches 96.4% over the range of 400–2000 nm.

Biography

Yumin Liu is currently working as a Professor of State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications. He dedicates to theoretical and experimental research work in the field of optical metamaterials and applications in sensing, solar energy, and optical communication devices. He has published more than 50 journals as an author or coauthor.

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