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Additive analysis of transmission-type all-dielectric encoding supergrating

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A transmission-type all-dielectric coded supergrating operating in the terahertz band is designed. The structure uses Si as the dielectric material to realize the change of transmission phase 2π in the band of $0.06 \sim 0.15$ THz. Compared with the conventional gratings, the transmission-type all-dielectric coded supergratings have the advantages of wide operating bandwidth, high transmittance, easy coupling with fiber, and low cost. It represents a new direction of optical coding technology and has a high application prospect and research value. We design a 1-bit all-dielectric coded supergrating. By changing the width of the grating element structure, two grating basic element structures with high transmission coefficients and continuous transmission phase changes of 180° are obtained. Based on the addition theorem of digital coding, the far-field scattering angle of the grating is controlled by encoding the basic unit structure of the grating, changing its arrangement order and physical superposition. Based on the generalized Snell theorem and the far-field scattering principle, the far-field scattering angle of the designed supergrating structure is calculated theoretically, and the characteristics of the simulation results are analyzed.

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A 1-bit transmissible all-dielectric coded supergrating element structure scheme is proposed. Two basic coding units with a phase difference of 180° are obtained by changing the width of the medium [1–3]. The supergrating consists of 24×24 cell structures. The encoding structure of supergrating at 0.1 THz frequency is designed by using addition theorem and far-field scattering principle. The far-field scattering characteristics are studied by theoretical calculation and simulation, and the feasibility of the coding rules is verified, as shown in Fig. 1.

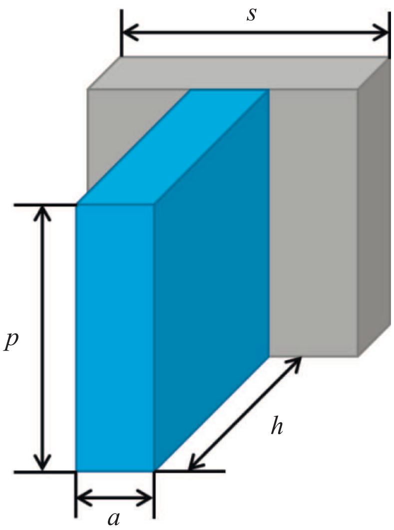

Fig. 1. (Color online) Structure diagram of the supergrating unit

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1. T. J. Cui, M. Q. Qi, X. Wan, J. Zhao, and Q. Cheng, Light Sci. Appl. **3**(10), e218 (2014).
2. Sh. Liu, T. J. Cui, Q. Xu, D. Bao, L. Du, X. Wan, W. X. Tang, Ch. Ouyang, X. Y. Zhou, H. Yuan, H. F. Ma, W. X. Jiang, J. Han, W. Zhang, and Q. Cheng, Light Sci. Appl. **5**(5), 767 (2016).
3. R. Y. Wu, Ch. B. Shi, Sh. Liu, W. Wu, and T. J. Cui, Adv. Opt. Mater. **6**(5), 1701236 (2018).

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