Reconfigurable moirénanolaser arrays with phase synchronization

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Miniaturized lasers play a central role in the infrastructure of modern information society. The breakthrough in laser miniaturization beyond the wavelength scale has opened up new opportunities for a wide rangeofapplications[1-4], aswell as for investigating light–matter interactions in extreme-optical-field localization and lasing-mode engineering [5-14]. An ultimate objective of microscale laser research is to develop reconfigurable coherent nanolaser arrays that can simultaneously enhance information capacity and functionality. However, the absence of a suitable physical mechanism for reconfiguring nanolaser cavities hinders the demonstration of nanolasers in either a single cavity or a fixed array. Here we propose and demonstrate moiré nanolaser arrays based on optical flatbands in twisted photonic graphene lattices, in which coherent nanolasing is realized from a single nanocavity to reconfigurable arrays of nanocavities. We observe synchronized nanolaser arrays exhibiting high spatial and spectral coherence, across a range of distinct patterns, including P, K and U shapes and the Chinese characters '中' and '国' ('China' in Chinese). Moreover, we obtain nanolaser arrays that emit with spatially varying relative phases, allowing us to manipulate emission directions. Our work lays the foundation for the development of reconfigurable active devices that have potential applicationsin communication, LiDAR (light detection and ranging), optical computing and imaging.

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