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DESIGN OF PIEZOELECTRIC LATTICE METAMATERIALS

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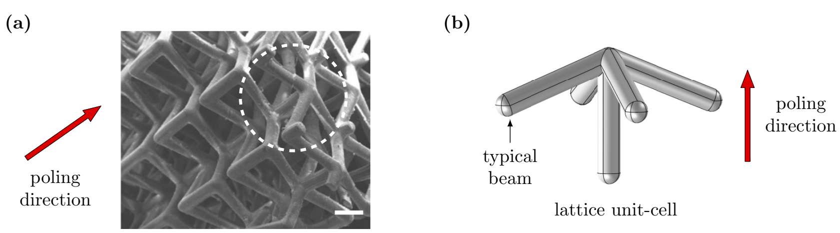
Piezoelectric materials have applications in pressure sensing, actuation, and energy harvesting, owing to their ability to convert mechanical to electrical energy and vice versa. Their piezoelectric constitutive relationships, dictated by their intrinsic crystallographic structures and compositions, are limited by the intrinsic crystalline orientation and occupy only a narrow area within the piezoelectric anisotropy space [1].



Here we explore piezoelectric lattice metamaterials. Their overall properties strongly depend on the spatial arrangement of their constituent base materials and can be controlled by changing the topology and geometry of the repeating unit cell. We analyze publicly available crystallographic network topologies, regarded as cellular structures with nodes connected by piezoelectric beams [2], and identify new structures with extremal piezoelectric properties. Instrumental in the homogenization process are the results of the Saint-Venant problem for general anisotropic piezoelectric cylinders [3], enabling the usage of a very efficient beam model even for beams whose axis is oblique to the poling direction.

References

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