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Bio-inspired Artificial Apposition Compound Eye JIANLIANG XIAO, University of Colorado Boulder, YOUNGMIN SONG, Pusan National University, YIZHU XIE, Hong Kong Polytechnic University, VIKTOR MALYARCHUK, University of Illinois at Urbana-Champaign, YONGGANG HUANG, Northwestern University, JOHN ROGERS, University of Illinois at Urbana-Champaign — In arthropods, evolution has created a remarkably sophisticated class of imaging system, with wide angle field of view, low aberrations, high acuity to motion and infinite depth of field. A challenge in building digital cameras with the hemispherical, compound apposition layouts of arthropod eyes is that essential design requirements cannot be met with existing planar sensor technologies or conventional optics. We present ideas in materials, mechanics and integration schemes that enable scalable pathways to working, arthropod-inspired cameras in nearly full hemispherical shapes with surfaces densely populated by imaging elements (i.e. artificial ommatidia). The devices combine elastomeric compound optical elements with deformable arrays of thin silicon photodetectors, in co-integrated sheets that can be elastically transformed from the planar geometries in which they are fabricated, to hemispherical shapes for integration into apposition cameras. Experimental and theoretical studies reveal key aspects of the materials science and physics of these systems. Imaging results and quantitative ray-tracing based modeling illustrate essential features of their operation.

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