Human-eye-inspired soft optoelectronic device using MoS_2-graphene curved image sensor array

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Soft bioelectronic devices provide new opportunities for next-generation implantable devices due in large to their minimal immune responses and tissue damages. However, a soft form of the optoelectronic device for optical sensing and retinal stimulation has not been developed yet mainly because of the rigidity and bulkiness of conventional imaging modules. In this study, we describe a human-eye-inspired soft optoelectronic device using a high-density curved image sensor (CurvIS) array that leverages the atomically thin MoS_2-graphene heterostructure and strain-releasing device designs. High photoresponsivity and infrared blindness are important benefits of the MoS_2-graphene-based ultrathin imager, and the CurvIS array successfully acquires pixelated optical signals. We corroborate the validity of the proposed soft materials and device designs through theoretical analysis based on mechanics and optics. The ultrathin CurvIS array is applied to the human-eye-inspired soft implantable optoelectronic device that can detect optical signals and apply programmed electrical stimulation to optic nerves with minimum mechanical side effects.