

WIDE BAND ABSORBING SILICON BASED MATERIAL FOR ENERGY HARVESTING: FROM BLACK SILICON TO METAMATERIALS

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In this paper, we discuss novel techniques to fabricate wide band absorption material to harvest energy in different bands. The first approach is to fabricate silicon nanowires to work as black silicon in the visible range. This approach utilizes simple and efficient approach that is capable of producing wideband absorption region that covers the whole visible range and increase the absorption efficiency to reach 99% over the whole band. The fabrication process is simple, efficient with high reproducibility. The measurements show also large oblique absorption >95% up to 60 degree angle of incident. In the second approach, we propose a mid IR silicon absorber using doped Silicon/Silicon Hyperbolic Metamaterial (HMM) integrated with sub-wave length Si grating. HMMs are characterized by their hyperboloid dispersion momentum space that provides large density of photonic states. By applying sub-wavelength grating on HMM, light from free space can be coupled to high propagation wave vectors of the hyperbolic modes upon breaking the momentum mismatch restriction, leading to noticeable absorption. We are able to show that an all Si based designed HMM is capable to achieve absorption across the mid IR wavelength range reaching absorption of value 0.9. This proposed CMOS compatible Si-based absorber serves as good candidate for IR thermal harvesting application for on chips purposes.

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