Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary information

Effect of Volatile Solvent Infiltration on Optical and Electrical Characteristics of Porous Photonic Structures

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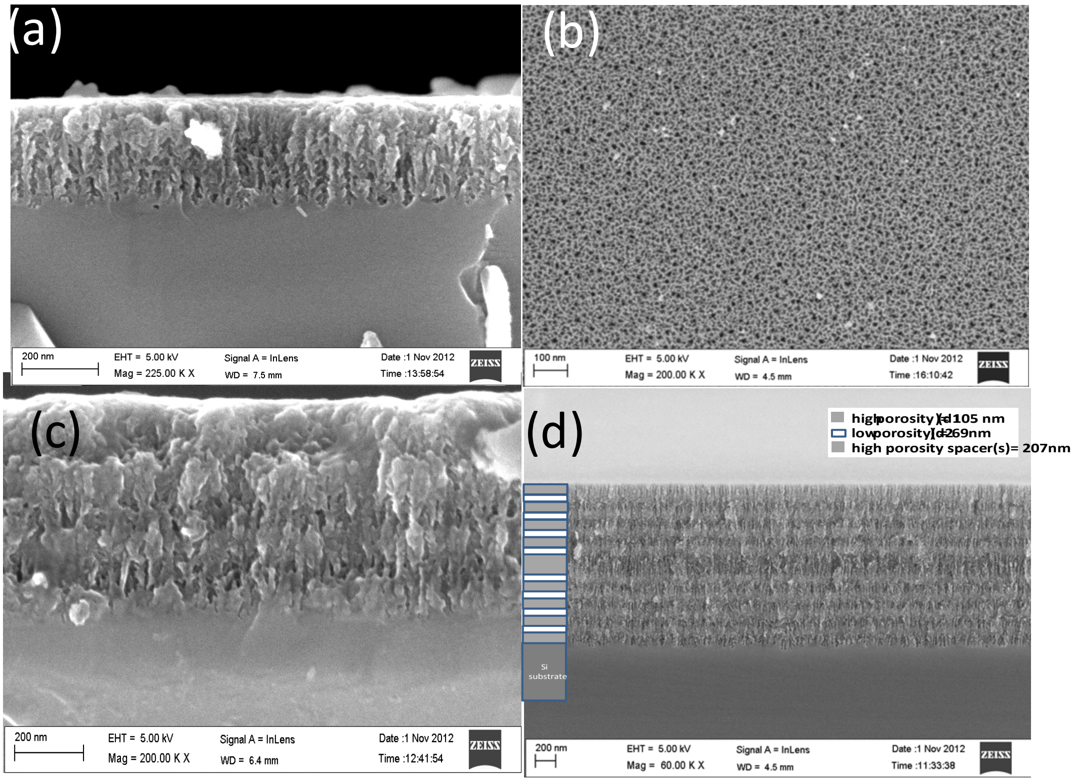
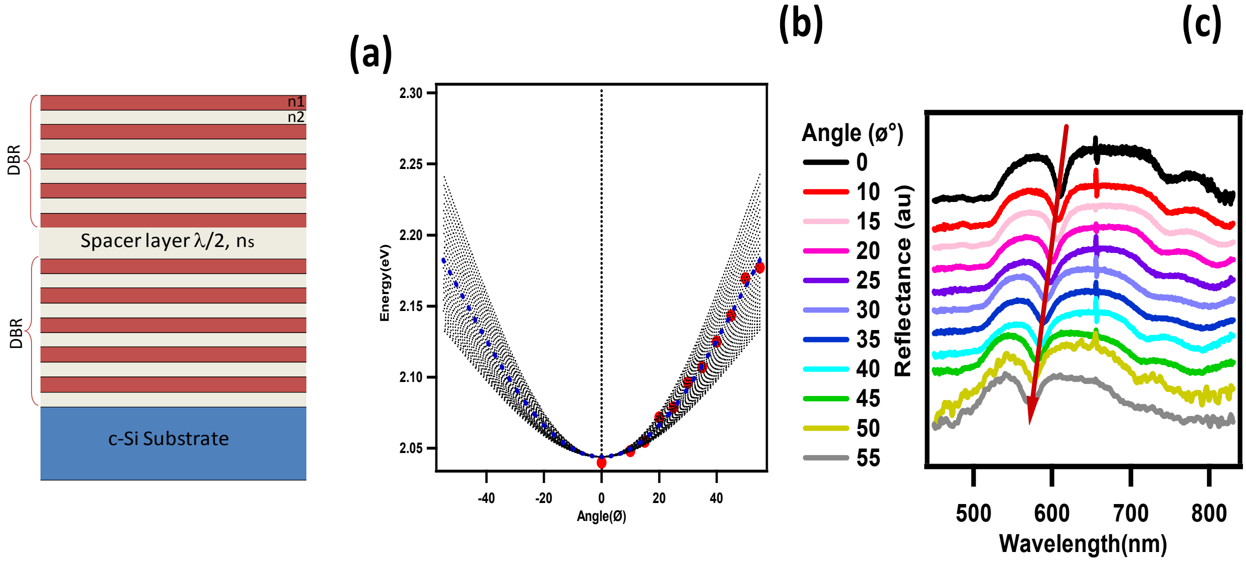
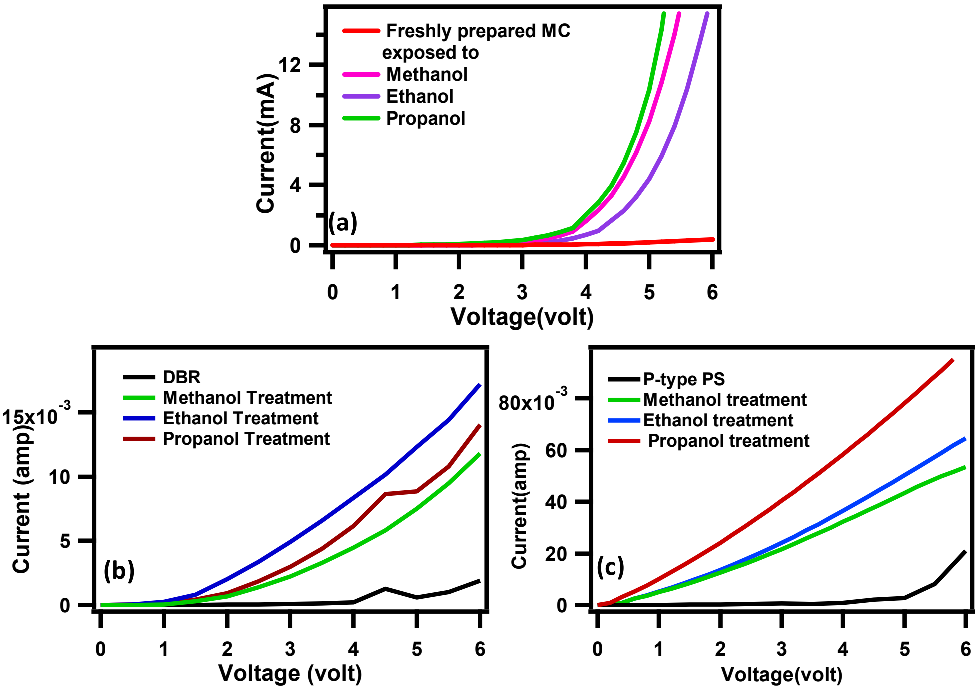


Sup. Fig.1. Example SEM pictures of (a) single porous layer cross-section and (b) top view (70% porosity), (c) Distributed Bragg Reflector (DBR) contains 8 layers of alternative porosities (n_1 and n_2) and (d) microcavity contains a spacer layer sandwiched between two DBRs.

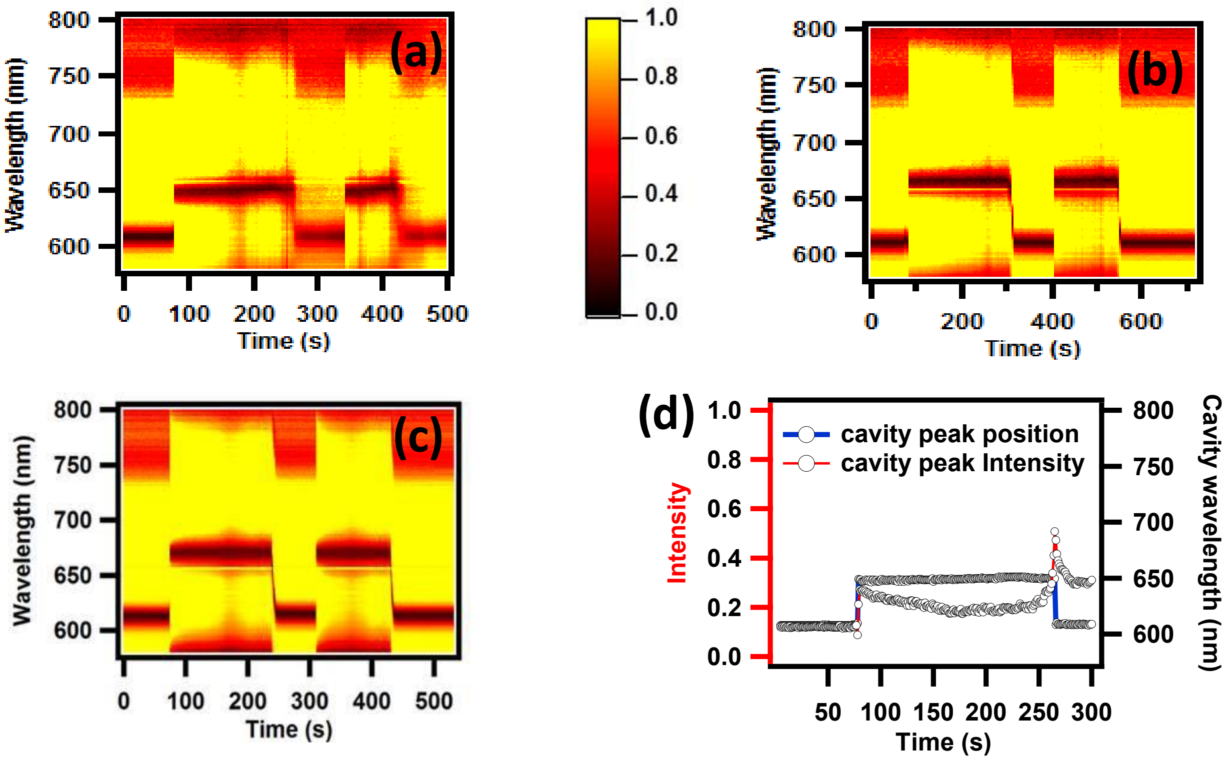


Sup.Fig.2 *(*a) Schematic of Microcavity having the structure of DBR-Spacer Layer-DBR, where the each layer thickness is λ/4 except spacer layer having thickness λ/2 (b) Microcavity cavity peak energy variation with angle. Red symbols are experimentally observed points and all dashed lines are from the cavity photon energy ($E_{ph}(\theta)$) variation with respect to angle (θ)as per Eq. 1, where n_{ff} is varied from 1.99 to 2.89(top to bottom). (c) Angle resolved experimental reflection spectra of microcavity (Y-axis shifted for clarity). The microcavity cavity photon energy is related to the angle of reflection by $E_{ph}(\theta) = E_c * \left(\sqrt{1-\sin^2\theta / n_{eff}^2}\right)^1$ (1)

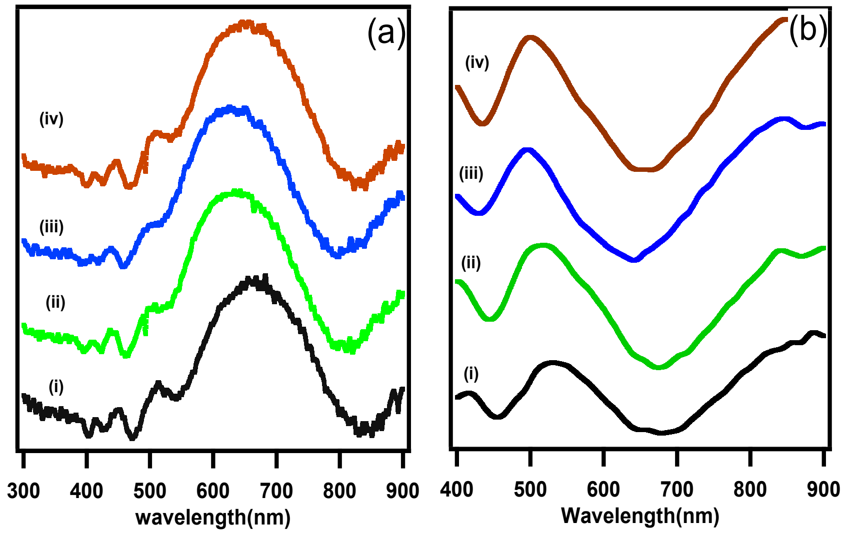
Where E_c is the cavity photon energy at normal incidence and n_{eff} is the effective refractive index. As seen in Fig.1, the angle tuning of microcavity mode and the experimental reflection cavity mode of bare cavity variation are matching well. From the experiments, the estimated un-perturbed cavity energy (E_c) is 2.04eV and the effective refractive index n_{eff} =2.33.



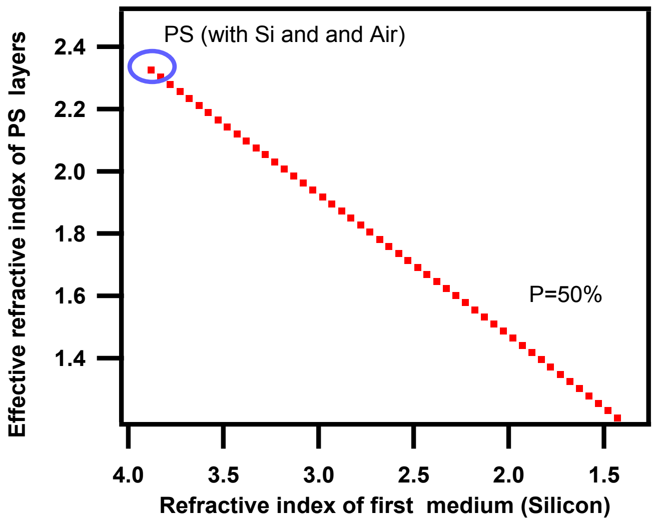
Sup. Fig. 3 Current-voltage measurement of (a) Microcavity (b) DBR, (c) p-type single layer. It is found that there is a different amount of current enhancement corresponding to different Solvent having different dielectric constant for all the photonic structures such as MC,DBR, p-type single layer.



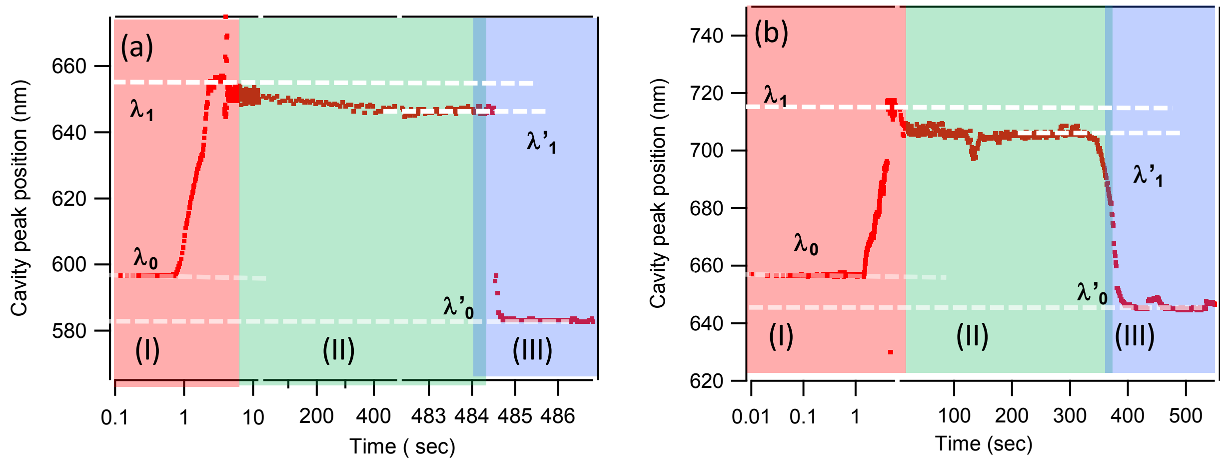
Sup. Fig. 4 Reflection spectral mapping of microcavity on various short-time exposures of (a) Methanol (b) Ethanol (c) Propanol. Figure (d) shows the extracted cavity peak (~613nm) variation (blue) and intensity (red) from Fig (a). The cavity resonances for shorter duration are consistently reversible for repeated exposure cycles.



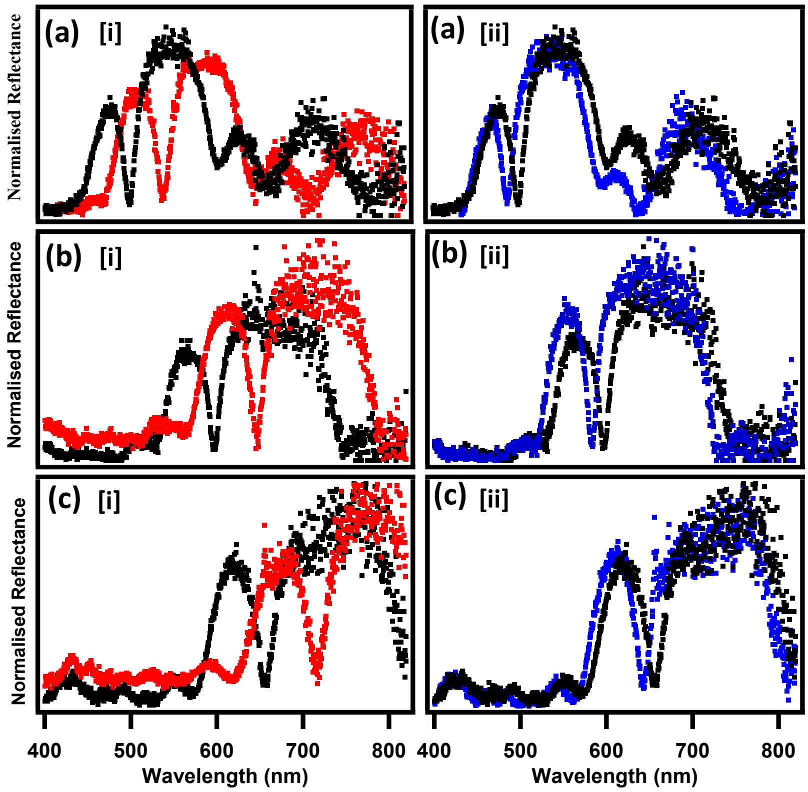
Sup. Fig. 5 Normalised reflection spectra of (a) DBR (b) Single PS (70% porosity) layer . The captions for reflection spectra are for (i) unexposed PS structure, after prolonged exposed and dried for solvents (ii) methanol, (iii) ethanol, (iv) propanol exposed respectively. In general, the spectral features of both DBR and single porous layers are also showed similar variation as in the case of microcavities (Fig5 and 6) upon solvent prolonged exposure. Since the spectral features are broad and the response is widely different for different solvents, therefore more specific discussion has been only made for cavity resonances of PS microcavity in Figure 5&6.



Sup. Fig 6 Simulated effective refractive index of single PS (p=50%) layer with an assumption that the 1st medium silicon (n_{si}= 3.6) is functionlised by unknown chemical species (see text). Here the refractive index of 2nd medium (n_{air}=1.0) and porosity/thickness remain constant. Thisis to support the experimental details related to figure 5.



Supl. Fig 6: PS Microcavity resonant peak dynamic variation during solvent (methanol) exposure (similar to Fig 5) for PS cavities of cavity resonances (a) 596nm and (b) 657nm. (see Fig 5 and related text for further information)



Supl. Fig 7: Normalised reflection spectra of PS Microcavities fabricated for different cavity resonances, (a) 493nm (b) 596nm and (c) 657 nm (black colour curves), compared with [i] corresponding reflection spectra (Red colour) during short time exposure to methanol (reversible) and [ii] corresponding recovered reflection spectra (blue color) after prolonged exposure and dried PS cavities (semi-permanent). See mail text for further information.