Growth and Formation of Inverse GaP and InP Opals - H.M. Yates, D.E. Whitehead, M.G. Nolan, M.E. Pemble (University of Salford), E. Palacios-Lidon (Instituto de Ciencia de Materiales de Madrid), S. Rubio, F.J. Meseguer (Universidad Politecnica de Valencia), and C. Lopez (Instituto de Ciencia de Materiales de Madrid)

Opals consist of an ordered array of SiO_2 spheres in a fcc lattice. This leads to a modulation of the refractive index and hence photonic behaviour over the visible/IR range of the electro-magnetic spectrum. The exact position of the stop bands depends on the size of the silica spheres (200 – 600 nm). However, the refractive index contrast between the SiO_2 spheres (n = 1.45) and air spaces (n = 1) is not great enough to open up a full photonic band gap (PBG), only the pseudogap. To increase the contrast (and hence possibility of a full PBG) the air spaces are filled with a material of high refractive index such as InP (n = 3.4) or GaP (n = 3.4). To further increase the contrast the SiO_2 is removed leaving a III-V framework as the inverse opal structure.

By use of atmospheric pressure MOCVD we have been able to infill opals with InP and GaP to 100% pore volume. This high infill has supported the inversion of the composite forming a structure of air holes within a III-V lattice. XRD and Raman confirmed the quality of the III-V infill, while the extent of the infill was studied by SEM and reflectance measurements.