Surface compositional profiles of InAs/GaAs quantum rings

S. Heun,1§ G. Biasiol,2 R. Magri,3 A. Locatelli,4 T. O. Mentes,4 L. Sorba1

1 NEST CNR-INFM and Scuola Normale Superiore, I-56126 Pisa, Italy
2 Laboratorio Nazionale TASC CNR-INFM, AREA Science Park, I-34012 Trieste, Italy
3 S3 CNR-INFM and Università di Modena e Reggio Emilia, I-41100 Modena, Italy
4 Sincrotrone Trieste S.C.p.A., I-34012 Trieste, Italy

The composition profile of self-assembled InAs/GaAs quantum rings is studied both experimentally and theoretically. 2D surface maps obtained by X-ray photoemission electron microscopy (XPEEM) reveal a non-uniform profile with an In-rich core, corresponding to the central hole of the ring, surrounded by a rim with stronger In-Ga intermixing. These results are substantiated by an atomistic Valence Force Field (VFF) model which, for a given shape, identifies the composition distribution that minimizes the elastic energy of the system. The VFF calculation predicts a preference for the In atoms to remain localized in the ring hole, in agreement with the experimental findings.

Fig. 1. a): 1000 nm x 480 nm low energy electron microscopy image of self-assembled InAs/GaAs quantum rings. b) Surface In composition of the same area measured by XPEEM. The length markers correspond to 200 nm.

§ Corresponding author, stefan.heun@sns.it