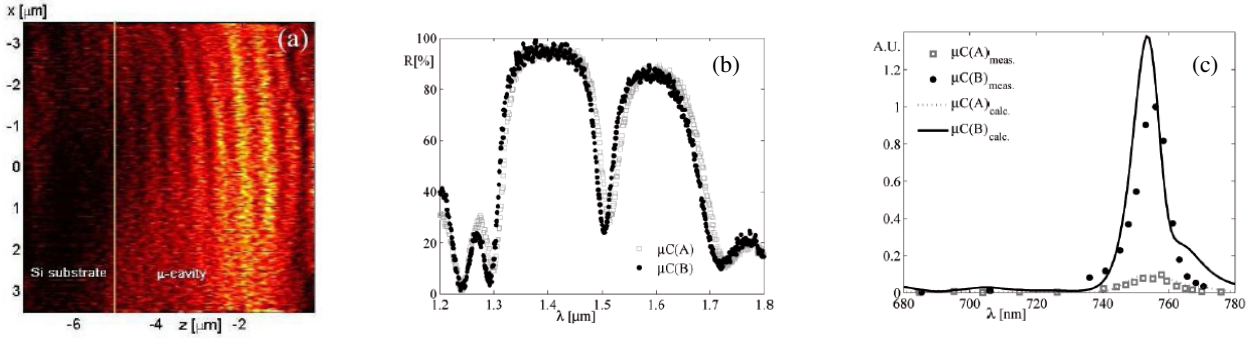
Field localization and enhanced harmonic conversion in Silicon-based periodic multilayers

E. Descrovi, C. Ricciardi, F. Giorgis
Materials and Microsystems Laboratory χLab - Physics Department – Polytehcnical University of Torino, C.so Duca degli Abruzzi 24, I-10129 Torino, Italy.
G. Lerondel
Laboratoire de Nanotechnologie et d'Instrumentation Optique / ICD, Universite de Technologie de Troyes CNRS (FRE2848), 12 rue Marie Curie, 10010 Troyes cedex, France
S. Lettieri, F. Gesuele and P. Maddalena
CRS Coherentia and Physics Department, University of Napoli 'Federico II', Via Cintia, I-80126 Napoli, Italy
M. Liscidini, L. C. Andreani
Physics Department "A. Volta", University of Pavia, Via Bassi 6, I-27100 Pavia, Italy

In the last decade, optical microcavities based on Silicon and related alloys have been intensively studied with the aim of analysing fundamental properties of light–matter interaction in terms of linear [1] and non linear processes [2], using single and doubly resonant structures whose design is based on photonic crystal concepts [3,4].
In this work, we focus the attention on a-SiN:H based stratified structures grown by PECVD with different lay-out having almost identical linear response but remarkable differences in Second Harmonic spectrum. We explain this finding on the basis of a theoretical model taking into account the spatial distribution of both the electric fields of the pump and the generated Second Harmonic (SH) inside the structure. Direct Near-field measurements of the pump field distribution performed by scanning the cleaved facet of the planar microcavities with a Near-field Optical Microscope (SNOM) yield such a localization. A satisfactory matching of experimental data can be obtained by considering the source of second-order nonlinearity as confined at interfaces rather than in the bulk multilayered material, since the Silicon based alloys are centrosymmetric [5].



a) SNOM intensity map at resonance; b) μc's reflectance spectra; c) reflected SH spectra [p-p config]

[1] F. Giorgis, Appl. Phys. Lett. **77**, 522 (2000)
[2] S. Lettieri, S. Di Finizio, P. Maddalena, V. Ballarini, F. Giorgis, Appl. Phys. Lett. **81**, 4706 (2002)
[3] S. Lettieri, F. Gesuele, P. Maddalena, M. Liscidini, L. C. Andreani, C. Ricciardi, V. Ballarini, F. Giorgis, Appl. Phys. Lett. **87**, 191110 (2005)
[4] M. Liscidini and L.C. Andreani, Phys. Rev. E **73**, 016613 (2006)
[5] S. Lettieri, F. Merola, P. Maddalena, C. Ricciardi, F. Giorgis, Appl. Phys. Lett. (2006, in press)