CUSPIDOR

CMOS Compatible Single Photon Sources based on SiGe Quantum Dots

*Thomas Fromherz*
SUCCESS STORY (highlights)

CHALLENGE – no CMOS compatible single photon sources emitting at telecoms available

SOLUTION – a) development of SiGe QD based sources; b) exploit SiGe non-linear optical effects enhanced by photonic crystal cavities for single photon generation.
SUCCESS STORY (highlights)

PLANNED AND SURPRISING/UNPLANNED OUTCOMES

Single QD emission of a SiGe QD integrated into a bichromatic photonic crystal resonator (PhCR)

World record Q-factor for QD loaded PhCRs for the SOI integrated optics platform
SUCCESS STORY (highlights)

PLANNED AND SURPRISING/UNPLANNED OUTCOMES

First demonstration of entangled photon pair generation by spontaneous four-wave mixing in a photonic crystal cavity.
SUCCESS STORY (highlights)

PLANNED AND SURPRISING/UNPLANNED OUTCOMES

a) Ab-initio description of energy structure of Ge defect enhanced quantum dots (DEQDS).

![Graph showing energy structure]

- Ge split-[110] interstitial has minimal formation energy
- LUMO has significant $\Gamma$ character
- Increased density of states

Results obtained by
K. Schwarz, P. Blaha (TU Vienna, Austria)
F. Murphy-Armando (Tyndall National Institute, Cork, Ireland)
M. Lusk, School of Mines, Colorado, USA

DFT super-cell calculations & band-unfolding*: significant changes compared to Ge bandstructure

*V. Popescu et al., PRB 85, 085201 (2012)

b) Mesoscopic modeling of DEQDs by k.p and empirical tight-binding (ETB) methods to describe larger QDs with a single split Ge interstitial defect.
IMPACT (RRI aspects)

Please include short examples of good Responsible Research and Innovation practices relevant for your project, addressing at least one RRI aspect

**GENDER:** fostering gender balance in research teams
PhD project advertisements were explicitly addressed to female students. Nevertheless only 11% of the project team were females.

**OPEN SCIENCE:** promoting transparency and reproducibility of research, increasing and widening the diffusion of knowledge
All data used in CUSPIDOR publications will be made available upon reasonable request.
IMPACT (potential users)

Please identify briefly a project with a potential commercial, industrial application

RELEVANT INDUSTRY BRANCH
Integrated quantum photonics at telecom wavelengths

KEY COMMERCIALLY RELEVANT APPLICATIONS
Quantum security by scalable technology

EXISTING/POTENTIAL END USERS
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