

## Silicon nanoparticles as Trojan horses for potential breast cancer therapy

Roberto Fenollosa,<sup>1</sup> Eduardo Garcia-Rico,<sup>2</sup> Susana Alvarez,<sup>3</sup> Rosana Alvarez,<sup>3</sup> Xiang Yu,<sup>4</sup> Isabelle Rodriguez<sup>5</sup>, Susana Carregal-Romero,<sup>4</sup> Carlos Villanueva,<sup>5</sup> Pilar Rivera-Gil,<sup>5</sup> Angel R. de Lera,<sup>3</sup> Wolfgang J. Parak,<sup>4</sup> **Francisco Meseguer**,<sup>1</sup> Ramón A. Alvarez-Puebla,<sup>6,7</sup>

<sup>1</sup> Centro de Tecnologías Físicas, Unidad Asociada CSIC-UPV, Universidad Politécnica de Valencia, Av. Los Naranjos s/n, Valencia, 46022 Spain

<sup>2</sup> Servicio de Oncología, Hospital Universitario Madrid-Torrelodones, 28250, Madrid, Spain

<sup>3</sup> Departamento de Química Orgánica, Universidade de Vigo, Vigo, 36310 Spain

<sup>4</sup> Fachbereich Physik, Philipps Universität Marburg, Marburg, 35037 Germany

<sup>5</sup> Medcomtech SA. C/ Catalunya, 83-85 Viladecans, Barcelona, 08840 Spain

<sup>6</sup> Departamento de Química Física e Inorgánica, Universitat Rovira i Virgili and Centro de Tecnología Química de Catalunya, Carrer de Marcel·lí Domingo s/n, 43007 Tarragona, Spain

<sup>7</sup> ICREA, Passeig Lluís Companys 23, 08010 Barcelona, Spain

<mailto:fmese@fis.upv.es>

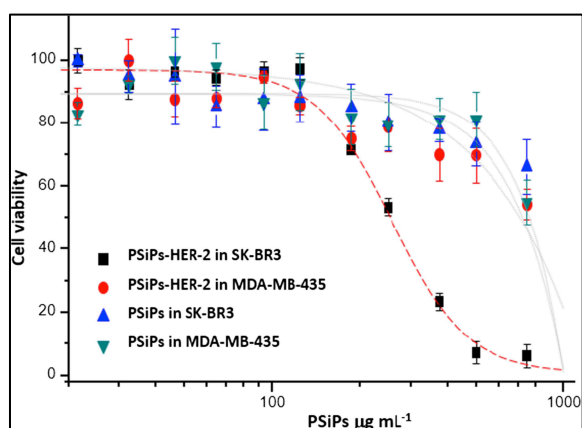
### Abstract

Over the last two decades nanoparticles have proven to have a great potential for drug delivery and disease treatment, particularly in cancer therapy strategies [1]. In the last years porous silicon nanoparticles have shown excellent properties as drug delivery carriers for cancer therapy due to their excellent biocompatibility and biodegradability [2]. It is well known from silicon producers that porous silicon nanoparticles present extremely high, and even explosive, oxidation reactions with enthalpy values exceeding that of Trinitrotoluene (TNT) [3]. Here we show that silicon nanoparticles can be used themselves as a cancer cell killer drug [4], thus avoiding the use any additional anticancer drug with serious side-effects. Targeted cells are destroyed through a mechanism that takes advantage of both the violent reaction of degradation of silicon in aqueous medium and the enzymatic machinery of eukaryotic cells. The use of silicon nanoparticle properly protected to avoid an extracellular solubilization, and coupled to an appropriated antibody, allows the selective destruction of the cancer cells, which is followed by the degradation of silicon into excretable biocomponents of the body. Figure 1 shows an example of how the breast cancerous cells (SK-BR3) viability dramatically decreases with porous silicon nanoparticles properly functionalized with the directing vector HER-2 positive breast cancer.

### References

- [1] Prasad, P.N. Introduction to Nanomedicine and Nanobioengineering. (Wiley, New York; 2012).
- [2] Park, J.-H. *et al. Nat Mater* **8**, (2009) 331; Popplewell, J.F. *et al. J. Inorg. Biochem.* **69** (1998) 177; Shabir, Q. *et al. Silicon* **3** (2011) 173.
- [3] Mikulec, *et al.*, *Advanced Materials*, **14** (2002) 38-41.
- [4] Fenollosa, R., *et al.*, *Journal of Nanobiotechnology* **12** (2014) 35

### Figures



**Figure 1: Cell viability.** Relative cell viability after incubation of SK-BR-3 and MDA-MB-435 cells with PSiPs and PSiPs-HER-2 for 48 h.