Kamikaze Silicon colloids as cancer cells killers.

Isabelle RODRIGUEZ[1], Roberto Fenollosa[1], Eduardo Garcia-Rico[2], Susana Alvarez[3], Rosana Alvarez[3], Xiang Yu[4], Susana Carregal-Romero[4], Carlos Villanueva[5], Manuel Garcia-Algar[6], Pilar Rivera-Gil[5], Angel R de Lera[3], Wolfgang J Parak[4], Francisco Meseguer[1] and Ramón A Alvarez-Puebla [6,7]

[1] Instituto de Tecnología Química and Centro de Tecnologías Físicas. CSIC/ Universitat Politècnica de València, Av. Los Naranjos s/n, 46022 Valencia, Spain.
[2] Servicio de Oncología, Hospital Universitario Madrid-Torrelodones ,Madrid 28250, Spain.
[3] Departamento de Química Orgánica, Universidade deVigo, Vigo 36310, Spain. [4]Fachbereich Physik, Philipps Universität Marburg, 35037, Germany. [5]Medcomtech SA, C/ Catalunya, 83-85 Viladecans, Barcelona 08840, Spain. [6]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. [7]ICREA, Passeig Lluís Companys 23, 08010 Barcelona, Spain.
mirodrig@upvnet.upv.es

Abstract
Nanoparticles have shown a great potential in nanomedecine [1]. In most approaches, surface functionalization of nanoparticles by antibodies, allows them to be directed to the target cells for drug delivery or also for heating treatment through magnetothermia [2] or photothermia [3]. A drawback of such techniques is the large and expensive facilities required and/or the limited efficiency. Porous silicon particles represent a promising platform for cancer therapies due to their good biocompatibility and biodegradability [4]. They have been largely employed as vehicle for drug administration. However, if one takes into account the well-known violent reaction of oxidation and degradation that silicon undergoes in aqueous medium [5], it appears that silicon nanoparticles themselves can constitute a lethal weapon if they could be introduced inside the target cells using a Trojan horse-like subterfuge. Here we present the demonstration of this concept through tests in vitro of viability of cancerous cells (SK-BR3). The strategy consists coating silicon nanoparticles with sugars to avoid the extracellular solubilization, followed by a functionalization with the appropriated antibody to target the desired cells. Once the functionalized silicon nanoparticles reach the target, the enzymatic machinery of Eukaryotic cells begin the degradation of particles into excretable elements. It can be seen in Figure 1 the decrease of the viability of cancerous cells after contact with silicon particles functionalized with the directing vector HER-2-positive breast cancer [6].

References

[1]Prasad, P.N. Introduction to Nanomedicine and Nanobioengineering. (Wiley, New York; 2012).
[2] Gomella, L.G. *Nat Clin Pract Urol* **1**(2004)72; Maier-Hauff, K. et al. *J Neurooncol* **103**(2011)317.
[3] Hong, C., et al.. *Anti-Cancer Drugs* **22**(2011)971; Lal, S., et al., *Accounts of Chemical Research* **41**, 1(2008)842; Lee, C. et al. *Journal of Materials Chemistry* **18**(2008)4790; Osminkina, L.A., et al. , *Appl. Phys. B* **105**(2011)665; Jain, P.K., et al., *Accounts of Chemical Research* **41**(2008)578.
[4] 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.
[5] Mikulec, FV., et al., *Adv Mater.* **14**(2002)38**;** Clement, D., et al., Phys Stat Sol A **202**(2005)1357.
[6] Fenollosa, R., et al. *Journal of Nanobiotechnology* **12**(2014)35

Figures

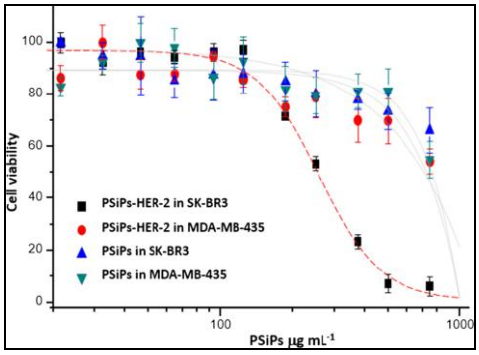

Figure 1: Cell viability. Relative cell viability after incubation of SK-BR-3 and MDA-MB-435 cells with PSiPs and PSiPs-HER-2 for 48 h.