Multifunctional polymersomes for cancer theranostics

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The concept of personalized medicine is drawing a lot of attention, pointing out the future for medical and pharmaceutical practices, where synthetic nanovectors could be considered as interesting tools. First generation vectors have proved their ability to reduce deleterious side effects, especially in cancer therapy. But the current trend aims at the elaboration of nanovectors that will be able to cross biological barriers, bind to the diseased site, release a drug in a controlled manner and act as an imaging agent for both diagnosis and treatment follow-up [1]. Thanks to their unique features, polymersomes have shown, in a relatively short period of time, their potential as both therapeutic and imaging tools and appear especially suited for the elaboration of multifunctional carriers. Here, we describe the production, characterization and evaluation *in vitro* and *in vivo* of a multicomponent, targeted polymersome system, focusing in a bone metastasis model (from breast cancer). Non-toxic, bioresorbable, amphiphilic block copolymer, poly(trimethylene carbonate)-*b*-poly(γ -benzyl-L-glutamate), forming polymersomes upon self-assembly, was functionalized using a hetero-bifunctional oligo(ethylene glycol) linker allowing the covalent grafting of antibodies targeting the HER2 receptor. A versatile strategy allowed the preparation in two steps of polymersomes loaded with both anticancer drug and magnetic iron oxide nanoparticles [2] and bearing antibodies at their surface. Efficient and selective targeting of HER2 expressing cells was demonstrated with these polymersomes (Fig. 1). They also elicited good properties as contrast agents for MRI and the drug release was triggered under magnetic hyperthermia, showing that these systems are promising tools for theranostic applications.

Fig. 1. Scheme of a multifunctional polymersome and *in vitro* evidence of its targeting properties.

Keywords: Multifunctional polymersomes, Theranostics, Magnetic resonance imaging, Drug delivery

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References

- [1] K. Riehemann, S.W. Schneider, T.A. Luger, B. Godin, M. Ferrari, H. Fuchs, Nanomedicine-challenge and perspectives, *Angew. Chem. Int. Ed.* 48 (2009) 872–897.
- [2] C. Sanson, O. Diou, J. Thévenot, E. Ibarboure, A. Soum, A. Brûlet, S. Miraux, E. Thiaudière, S. Tan, A. Brissot, V. Dupuis, O. Sandre, S.b. Lecommandoux, Doxorubicin loaded magnetic polymersomes: theranostic nanocarriers for MR imaging and magneto-chemotherapy, *ACS Nano* 5 (2011) 1122–1140.