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A new microfluidic methodology to assess the haemocompatibility of magnetic nanoparticles designed for theranostic applications

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The remarkable physicochemical properties of magnetic nanoparticles (MNPs) at the nanoscale have boosted the development of new and promising strategies for the simultaneous diagnosis and treatment of diseases, particularly in cancer therapy and the so-called theranostic applications (1). In these strategies, the intrinsic superparamagnetic properties of MNPs have been exploited to gain access into multifunctional systems able to simultaneously perform as enhanced magnetic resonance imaging (MRI) contrast agents, efficient nanocarriers for drug delivery and nanoheaters in magnetic hyperthermia based therapy (2), among others. Nevertheless, the lack of biocompatibility and haemodynamic studies, hamper the consolidation of the multifunctional nanoparticles as the next generation of therapeutic bio-agents in medicine. In order to gain deeper insight into the complex nanoparticle-red blood cells (RBCs) membrane interaction, a novel microfluidic methodology was developed based on the human RBCs deformability as an indicator of haematological pathologies and disorders (3). For this purpose, a microfluidic device with a hyperbolic channel based on the extensional flow approach and a high-speed video microscopy system was used. The microfluidic flow results revealed the higher accuracy of the novel presented methodology compared to the traditional tests (haemolysis analysis), since smaller increments in the rigidity of the RBCs can be detected. The rigidity alterations have been reported to be due to the wrapping of small MNPs by the bilayer membrane of the RBCs, which is directly related with the MNPs size,

shape and composition (4). Overall, the proposed microfluidic methodology represents a new concept for nanomedicine, allowing for a more accurate evaluation of the haemocompatibility of MNPs targeting clinical applications.

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References

- (1) Hervault, A.; Thanh, N.T.K. *Nanoscale*. 2014, 6, 11553.
- (2) Ito, A.; et al. *J. Biosci. Bioeng.* 2005, 100, 1.
- (3) Sabo, A.; et al. *Int. J. Clin. Pharmacol. Ther. Toxicol.* 1993, 31, 1.
- (4) Curtis, E.M.; Bahrami, A.H.; Weikl, T.R.; Hall, C.K. *Nanoscale*. 2015, 7, 14505.