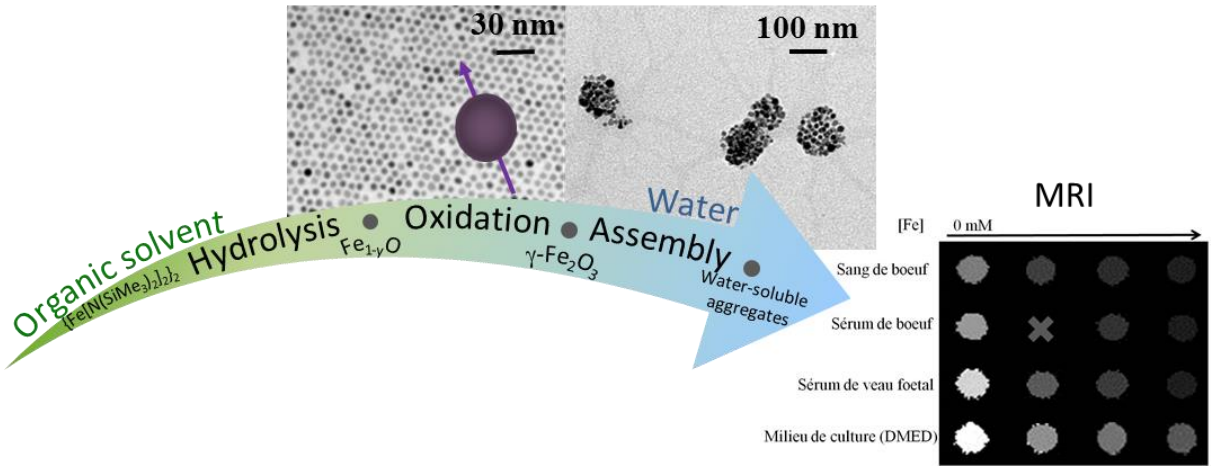
**Oxydation route determines the magnetic and relaxivity properties of iron oxide nanocrystals: toward highly efficient MRI contrast agent**

Gérald Casterou,[a,b] Pierre-Antoine Eliat,[c] Fabienne Gauffre,[b] **Myrtil L. Kahn**[a]

a) Laboratoire de Chimie de Coordination-CNRS, 205 route de Narbonne, 31077 Toulouse, France, email: myrtil.kahn@lcc-toulouse.fr
b) Institute of Chemical Sciences of Rennes, University of Rennes/CNRS, France
c) PRISM - Biosit CNRS UMS 3480, INSERM UMS 018, Rennes, France.
myrtil.kahn@lcc-toulouse.fr

**Abstract**

The synthesis of ultrasmall superparamagnetic iron oxide nanocrystals (USPIO) with controlled size distribution and crystallinity has been a constant challenge for advanced applications such as MRI or hyperthermia, which require specific magnetic features.[1-3] Using an organometallic approach, we investigate independently the hydrolysis and oxidation steps in the synthesis of USPIO. The USPIO were investigated by a variety of analytical techniques and we demonstrate that the oxidation route influences the structural and magnetic properties of the USPIO. In particular, the property most directly related to the efficiency of MRI contrast agents, the magnetic relaxivity, appears to depend critically on the elaboration process. Thus, starting from highly homogeneous wüstite ($Fe_{1-y}O$) Ncs, the selection of the oxidation pathway led to maghemite ($\gamma$-$Fe_2O_3$) Ncs optimized for MRI. Finally, the USPIO are assembled into SPIO (superparamagnetic iron oxide) aggregates of ca 150 nm, which are water dispersable and exhibit relaxivity values ca 4 time higher than the commercial Feridex® MRI contrast agent. Such SPIO aggregates are moreover stable in a lot of different physiological media (beef blood, beef serum, foetal calf serum, DMED cell culture). These SPIO aggregates consequently exhibit a significant decrease of the signal even with a very short echo time of 8 ms which is of paramount importance in clinical trials because it significantly decreases the duration of the MRI measurement and can significantly improve the patient's well-being.[4]




**References**

[1] Kim, S.-G.; Harel, N.; Jin, T.; Kim, T.; Lee, P.; Zhao, F. NMR Biomed. **26** (2013) 949.
[2] Lodhia, J.; Mandarano, G.; Ferris, N.; Eu, P.; Cowell, S.; Davidson, R. Biomed. Imaging Interv. J. **6** (2010) e12.
[3] Laurent, S.; Forge, D.; Port, M.; Roch, A.; Robic, C.; Vander Elst, L.; Muller, R. N. Chem. Rev. **108** (2008) 2064.
[4] Gérald Casterou, Vincent Collière, Pierre Lecante, Yannick Coppel, Pierre-Antoine Eliat, Fabienne Gauffre and Myrtil L. Kahn (2015) soumis