Results: The synthesis was accomplished in water milieu without the need of hydrophobic adaptor molecules and similar intermediates. We used an advantage of the presence of multiple silver-reducing aldehydes that are available on the surface of freshly-prepared dextran-stabilized ultra small iron oxide nanoparticles to induce the formation of nanocolloidal silver layer after treating with 20.5±4.6 nm dextran-stabilized iron oxides with an excess of Tollens reagent (diamminesilver(I) nitrate). After size-exclusion chromatography we isolated 34.0±9.5 nm silver-containing nanoparticles with unimodal size distribution and characteristic absorbance peak at 405 nm (Fig. 2) that showed increased scattering of X-rays upon examining with a back-scattered electron detector. Incubation of these silver-tagged nanoparticles in diluted solutions of tetrachloroauric acid in the presence of excess of Tollens reagent (diamminesilver(I) nitrate) resulted in the formation of small, electron dense single-core negatively charged nanoparticles (30.9±9.6 nm, zeta potential – 19 mV), Fig 2 that had further increased electron backscatter. These nanoparticles could be additionally purified using density gradient ultracentrifugation that resulted in the separation of iron oxides that were not associated with dense gold nanoparticles. The hybrid gold-iron oxide nanoparticles (IO-Ag-Au NP) were stabilized using stable absorption of PEGylated poly amino acid MPEG-gPLL (graft copolymer of MPEG5000 and poly-l-lysine graft copolymer) resulted in the formation of small, electron dense single-core negatively charged nanoparticles (30.9±9.6 nm, zeta potential – 19 mV), Fig 2 that had further increased electron backscatter. These nanoparticles could be additionally purified using density gradient ultracentrifugation that resulted in the separation of iron oxides that were not associated with dense gold nanoparticles. The hybrid gold-iron oxide nanoparticles (IO-Ag-Au NP) were stabilized using stable absorption of PEGylated poly amino acid MPEG-gPLL (graft copolymer of MPEG5000 and poly-l-lysine graft copolymer) that resulted in the formation of small, electron dense single-core negatively charged nanoparticles (30.9±9.6 nm, zeta potential – 19 mV), Fig 2 that had further increased electron backscatter. These nanoparticles could be additionally purified using density gradient ultracentrifugation that resulted in the separation of iron oxides that were not associated with dense gold nanoparticles.

Fig. 1. A schema of IO-Ag-Au nanoparticle synthesis and stabilization in the presence of MPEG-gPLL copolymer.

Fig. 2. Transmission electron microscopy of IO-Ag and IO-Ag-Au (magnification – 140Ks) shows the presence of the spherical electron-dense nanoparticles (diameter 6.8-9.6 nm) only after treating with HAuCl4 solution.

Conclusion: The hybrid gold-iron oxide nanoparticles were obtained via a facile water-based synthesis using an accessory silver layer prior to depositing a surface layer of gold. The obtained nanoparticles had high molar relaxivity and were stabilized for better biocompatibility.

\[ \text{References:} \]