Purpose:The use of high-Z nano-particles (NP) increases the dose in the nearby volume by absorbing more photons of keV energy. The resulting electrons deposit the dose locally. Additionally, Auger electrons are generated. In combination with tumor specific agents such a dose deposition mechanism could provide an efficient methodology to increase dose to microscopic disease.
To quantify dose enhancement and spectral changes in the vicinity of these particles we propose the use of GaF-chromic film which can be analyzed using scanning electron microscopes (SEM) to yield microscopic insight in the processes at hand.
Materials Measurements were performed using a clinical RT-simulator (40kVp). GaF-chromic active layer only film was coated with a layer of gold NP's of about 30nm thick. The film and its control was irradiated with the NP downstream from the source to a dose of 0.01Gy.
The samples were characterized by means of the SEM unit of the FEI Dualbeam Nova 600 Nanolab.
The resulting images showed a landscape with a number of tracks which we hypothesize to be electron tracks. The images were processed using a skeletonization technique based on mathematical morphology, yielding the number of tracks and a quantification of the track length. A monte carlo simulation using a 40keV photon beam was performed. Spectral histograms were generated using CSDA tables converting track length to energy.
Results :Good agreement between the two histograms exist. The low energy portion of the MC-simulation fails as electrons with energies lower than 10keV are not tracked. We also see a larger peak at the track length histogram most probably due to the finite resolution of the film.
Conclusions: We have shown that GaF-chromic films can be used to gain insight in the overall dose deposition and enhancement at a microscopic level. Additionally, the spectral information was obtained.