
Synthesis and characterization of iodinated polymer particles and use as a contrast agent for tomography using a spectral scanner

Joëlle Balegamire^{*1}, Yves Chevalier¹, Hatem Fessi¹, Daniel Bar-Ness^{2,3}, Salim Si-Mohamed⁴, Monica Sigovan^{2,4}, Loïc Boussel^{2,4}, Philippe Douek^{2,4}, and Marc Vandamme⁵

¹Laboratoire d'Automatique et de Génie des Procédés (LAGEP) – CNRS : UMR5007, Université Claude Bernard - Lyon I – 69622 Villeurbanne, France

²Centre de Recherche en Acquisition et Traitement de l'Image pour la Santé (CREATIS) – Institut National de la Santé et de la Recherche Médicale - INSERM, Université Claude Bernard - Lyon I, CNRS : UMR5220 – 69621 Villeurbanne, France

³CERMEP- Imagerie du vivant – Hospices Civils de Lyon, Centre national de la recherche scientifique - CNRS (France), Institut National de la Santé et de la Recherche Médicale - INSERM, Université Claude Bernard - Lyon I, CHU Saint-Etienne – 69677 Bron, France

⁴Hospices Civils de Lyon (Radiology Department) – Hospices Civils de Lyon – 69677 Bron, France

⁵VOXCAN – VOXCAN – 69280 Marcy-l'Étoile, France

Résumé

Contrast agents are often used in medical imaging and more specifically in x-ray based imaging techniques to enhance image contrast, therefore improve quality of diagnosis. A good contrast media must have the highest attenuation coefficient (radiopacity), among other criteria. Polymers can be made radiopaque by blending them with heavy metals (good radio-opacifying agents due to their high atomic number). A cause of trouble is the leakage of heavy metals into the body. In order to avoid this issue, the contrast agent should be attached to the polymer material. The purpose of this study is to develop iodinated polymer nanoparticles which will be used as contrast agents for tomography using a Spectral Photon Counting Computed Tomography (SPCCT Scanner).

The iodinated polymer was prepared by covalently linking an iodinated molecule onto Poly(vinyl alcohol). The radiopaque moieties were successfully incorporated onto the polymer and the grafting ratio, calculated by ¹H NMR, is over 50%. Nanoparticles of iodinated polymers were prepared using the Nano-precipitation method. Particle size was measured by Dynamic Light Scattering (DLS) and Transmission Electron Microscopy (TEM); stability was assessed over time. Radio-opacity of the contrast media was evaluated in-vitro on phantoms prepared with suspensions of contrast agents at different concentrations and in-vivo by experiments performed on small animals (intravenous injections to rabbits). X-ray absorption were measured on a conventional CT and on the SPCCT.

The objective is to assess the benefits of the spectral scanner in comparison to a standard CT. It is expected that the photon counting detector of the SPCCT will improve the signal-to-noise ratio. Since the K-edge of iodine is too low, those iodinated nanoparticles will be loaded with other heavy metals in order to allow specific observation at the K-edge of the heavy atoms, in the future.

*Intervenant

Mots-Clés: Iodinated polymers, Contrast agents, SPCCT (Spectral Photon Counting CT), Radiopacity