Wednesday, November 9, 2016 - 15:30 to 17:00
Strand Session: Materials Development for Medical Applications

Radiation-engineered polymer nano-platforms for targeted drug delivery

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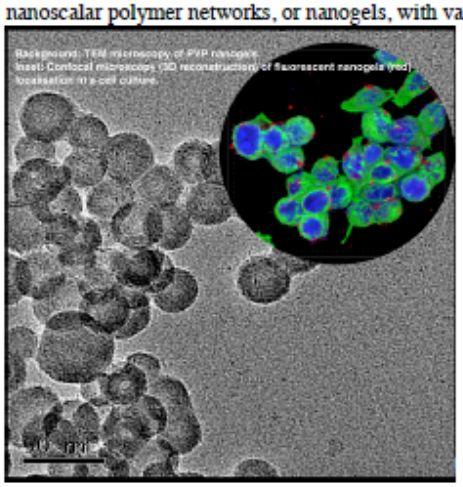
In the last twenty years, several nanobiomaterial-based nanocarriers, so-called nanoplatforms, have been proposed for the treatment of life-threating or quality-of-life-impairing diseases. The role of the nanocarrier is to increase drug localisation via passive and active targeting, to protect the drug from degradation and premature clearance, to facilitate its bypass through biological barriers and increase uptake by cells. For a successful translational research, the system composition should be as simple as possible, and the manufacturing processes should be fast, flexible and should enable a rapid product development from lab-scale to low cost, large-scale production.

With this focus, we have developed a polymer-based nanoplatform, which adopts as a main manufacturing step an industry-standard EB sterilisation process (10 MeV, 10 kW linac accelerator at INCT, Poland; 300-400 Hz, 20 or 40 kGy per pass).

Starting from aqueous solutions of poly(N-vinyl pyrrolidone), varying polymer concentration and absorbed dose, we have obtained a family of nanoscalar polymer networks, or nanogels, with various, controlled particle sizes.



Reactive functional groups (carboxyl groups and amino groups) have been generated by irradiation, which contribute to the colloidal stability of the nanoparticles and can be used for covalent conjugation of antibodies and peptides to provide active targeting functions, and therapeutic moelcules. The properties of these nanoparticles as delivery nanodevices, from in-vitro and in vivo studies, will be here presented. Their prospects as nanocarriers for anticancer therapies or for brain targeted insulin delivery in the treatment of Alzheimer's disease will be also discussed.

References:

[1] Picone P, Ditta LA, Sabatino MA, Militello V, San Biagio PL, Di Giacinto ML, Cristaldi L, Nuzzo D, Dispenza C, Giacomazza D, Di Carlo M, Ionizing Radiation-Engineered Nanogels as Insulin Nanocarriers for the Development of a New Strategy for the Treatment of Alzheimer's Disease. BIOMATERIALS 2016, 80, 179-194.
[2] Dispenza, C.; Sabatino, M.; Grimaldi, N.; Mangione, M.; Walo, M.; Murugan, E.; Jonsson, M.On the origin of functionalisation in one-pot radiation synthesis of nanogels from aqueous polymer solutions". RSC ADVANCES 2016, 6(4), 2582-2591.
[3] Dispenza, C; Grimaldi, N; Sabatino, MA; Soroka, IL; Jonsson M Radiation engineered functional nanoparticles in aqueous system. Invited Review for JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 2015, 15(5), 3445-3467(23).
[4] Dispenza C, Sabatino MA, Grimaldi N, Bulone D, Bondi ML, Casaletto MP, Rigogliuso S, Adamo G, Ghersi G. Minimalism in Radiation Synthesis of Biomedical Functional Nanogels. BIOMACROMOLECULES 2012, 13, 1805-1817.