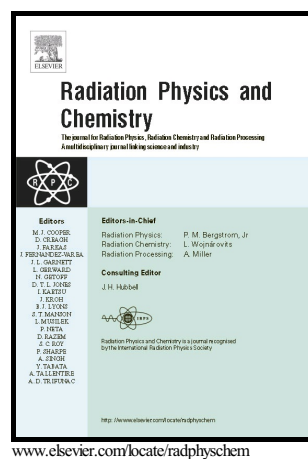


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Radiation-induced synthesis of poly(acrylic acid) nanogels

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Abstract

Nanogel is a two-component system of a diameter in the range of tens of nanometers, consisting of an intramolecularly crosslinked polymer chain and solvent, typically water, filling the space between segments of the macromolecule. Microgels are bigger than nanogels and their size range is between 100 nm to 100 μ m. One of the methods used for synthesizing nanogels is linking the segments of a single macromolecule with the use of ionizing radiation, by intramolecular recombination of radiation-generated polymer radicals. The main advantage of this technique is absence of monomers, catalysts, surfactants or crosslinking agents. This method is an interesting alternative way of synthesizing polymeric carriers for biomedical applications.

The aim of the study was radiation synthesis and characterization of poly(acrylic acid) – PAA – nanogels and microgels. The physico-chemical properties were described by determination of weight-average molecular weight and dimensions (radius of gyration, hydrodynamic radius) of the nanogels and microgels. Influence of polymer concentration and dose on these parameters was analyzed. Adjusting the PAA concentration and absorbed dose, one can control the molecular weight and dimensions of nanogels. The solutions of PAA were irradiated with two sources of ionizing radiation: γ -source and electron accelerator. The former method yields mainly microgels due to prevailing intermolecular crosslinking, while the latter promotes intramolecular recombination of PAA-derived radicals and in consequence formation of nanogels. In the future radiation-synthesized PAA nanogels, after functionalization, will be tested as carriers for delivering radionuclides to the tumor cells.

Keywords

nanogel; microgel; radiation synthesis; intramolecular crosslinking

1. Introduction

Nanogel is at least a two-component system of several tens of nanometers diameter, comprising an internally crosslinked macromolecule and a solvent filling the space between the chain segments (Ulanski and Rosiak, 2004). Another definition describes nanogel as a gel particle which may be of any shape with the size between 1 and 100 nm. Microgels are bigger analogues of nanogels and their size range is between 100 nm and 100 μ m (IUPAC, 1997).

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