SAXS Analysis of Stability and Anisotropic Properties of G/GMP Hydrogels

Federica Carducci[1*], Juliana Sakamoto Yoneda[2], Rosangela Itri[2], Paolo Mariani[1]

[1]*Department of Life and Environmental Sciences, Università Politecnica delle Marche, Ancona, Italy*
[2]*Instituto de Fisica, Universidade de São Paulo, São Paulo, Brazil*

** f.carducci@univpm.it*

The ability of guan(os)ine and guan(os)ine derivatives in aqueous or organic solution to self- assemble in supramolecular structures, from Hoogsteen-bound G-quartets to G-ribbons and G-quadruplexes, is an attractive unique feature of this low molecular weight compound. Metal-ion induced guanosine-based G-quadruplexes have been first reported in the early 1960s[1] and their structural properties and interactions were fully analysed[2]. It is now well-known that aqueous solutions of guanosine compounds can form gels through G-quadruplex self-assembly: stable hydrogels at neutral pH over a wide temperature range were in particular found in binary mixtures of 5'-guanosine monophosphate (GMP) potassium salt, and guanosine (G). These hydrogels are able to entrap water and could be used in a wide range of biotechnological and clinical applications as cellular immobilization, drug delivery, biomolecules separation if the gelation properties are controlled and convenient[3].
In our work, we focused on the swelling behavior, temperature stability and anisotropic properties of GMP/G hydrogels. Indeed, gelation was studied over the temperature range of 5-90 °C using visual detection, while 2D-Small Angle X-ray Scattering images were used to derive at different composition and hydration the structural properties of the gel. For the lower G/GMP investigated ratios, a characteristic butterfly scattering in the SAXS 2D images confirmed the presence of an ordered phase. Azimuthal scans were then used to quantify the hydrogel orientation state and to derive the temperature-concentration dependence of the G-quadruplex order parameter.
This novel weak chiral hydrogel medium formed by the self assembly of GMP/G, reversible over a broad range of temperature and concentration of the mixture and characterized by an order parameter that can be systematically tuned by external factors, has enormous potential for the measurement of molecular anisotropy of small and medium sized water-soluble molecules and for differentiate enantiomers and enantiotopic directions.

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