ProBioTion project: towards the formation of protein bioplastics using ionizing radiations

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ABSTRACT:

The valorization of bioresources is an environmentally friendly alternative for substituting crude oil-based plastics. Proteins are promising candidates for the production of biomaterials due to their thermoplastic properties, biodegradability and structural diversity. Teams of IPHC, IS2M and Aerial are combining their expertise to develop self-supporting protein films, and protein-functionalized materials, by irradiation. Ionizing radiation (10 MeV electrons at Aerial and proton beams) are used to ensure the cohesive structure of the films, avoiding the addition of crosslinking agent. Composite materials will be developed based on polymers functionalized at their surface by proteins presenting enzymatic activity, which will be coupled by radiolysis.
The thermomechanical properties of the materials, the degree of crosslinking and the enzymatic activity of the proteins will be evaluated.

When exposed to 10 MeV electrons beams, at doses above 50kGy, aqueous solutions of 30% w/w Bovine Serum Albumin (BSA) were converted into insoluble gels (**Figure 1**). Increasing dose resulted in a rise of the gelation rate (determined by HPLC and gravimetric measurements) and a concomitant decrease of the swelling of the gel. The secondary structure of the protein was affected with a slight conversion of alpha helices into beta structures at doses above 80kGy. In contrast, under identical conditions, lysozyme, an enzyme, gave rise to hydrosoluble gels, in which the protein retains its native conformation.
First results with 2 MeV accelerated protons will also be presented.

Figure1 : Evolution with the dose of the aspect of a 30% w/w BSA solution under irradiation by 10 MeV electrons