266th American Chemical Society National Meeting
Division of Medicinal Chemistry
August 13-17, 2023, San Francisco, CA
Abstracts

New insights into the organization of extracellular matrix macromolecules

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The extracellular matrix (ECM) is a network of biopolymer molecules (e.g., proteins) that provides structure to cells and tissues in the body. The ECM plays an important role in cell functions, such as cell growth, cell movement and is involved in repairing damaged tissue. Certain changes in the structure and function of ECM may lead to the development of diseases (e.g., cancer). The role of the ECM is defined by its composition, e.g., in cartilage it resists compression. Cartilage ECM synthesized by chondrocytes is mainly composed of type II collagen (approximately 25 % of dry weight). Other abundant macromolecules are glycosaminoglycans (mainly aggrecan and hyaluronic acid), which form large complexes containing aggrecan molecules condensed on linear hyaluronic acid chains. Aggrecan is a highly charged bottlebrush shape molecule. The aggrecan/hyaluronic acid complexes provide osmotic resistance to cartilage under external pressure. The osmotic role of the collagen matrix is limited. It immobilizes the aggrecan/hyaluronic acid complexes and provides tensile stability of cartilage.

We made systematic measurements on well-defined model systems to determine the physical properties of the major components of the ECM and the interactions among them. At the macroscopic level we made mechanical and osmotic swelling pressure measurements. The dynamic properties were evaluated from rheological measurements. These observations were complemented by higher resolution measurements (atomic force microscopy, small angle neutron scattering, small angle x-ray scattering, static and dynamic light scattering and neutron spin-echo) probing the interactions at the molecular level. We report new results obtained by the above complementary experimental techniques.