

Contribution of Fumio Oosawa to Soft Matter Physics

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Fumio Oosawa is well-known as one of founders of Biophysics in Japan. In his early career, he also made pioneering contributions in the field of colloid and polymer science, which is now called “soft matter” physics. This paper reviews his early studies, which were sometime believed made by a different person.

Fumio Oosawa studied physics under the guidance of Masao Kotani at University of Tokyo. When completed his Ph.D, he hoped to do non-orthodox physics, and subsequently started his career at Nagoya University and studied the sedimentation of soil dispersions with Naomi Miyabe, who was a student of Torahiko Terada. He then shifted his study to solution theories of polymers including polyelectrolytes using his profound understanding of static mechanics. Among them, the most famous work should be those about the “depletion force”. He and Sho Asakura wrote the first paper on the theory, called “A-O theory”, on the depletion [1]. When particles are dispersed in polymer solution, attraction called depletion force appears between the particles due to lower osmotic pressure between them than in the bulk. He later mentioned that he was inspired by the study on the coagulation of red blood cells conducted by Taro Tachibana and Kiyoshi Inoguchi of Ochanomizu University who demonstrated the coagulation of the cells by the addition of polymers [2]. The first, one page, paper on the depletion theory [1] was not noticed for 30 years after published, but now has the record of more than 2000 citations. This achievement is often referred as a good story at recent international conferences around the world. A book “Colloids and the Depletion Interactions” by the Dutch scientists, H. N. W. Lekkerkerker and R. Tuinje, describes early developments of the “depletion interactions”.

Another well-known study by Oosawa can be those on polyelectrolytes. When the charges along a polyelectrolyte chain exceeds the critical value, the counterions condense around the chain due to the Coulomb interaction. He created a simple model for this counterion condensation[4]. His studies are summarized in his famous monograph “Polyelectrolytes” [5], which are also regularly cited in papers on polyelectrolytes. In his memoir [6], Oosawa wrote that his study on the deformation of rubber should be found sometime. We appreciate his contributions to soft matter physics based on his deep understanding of static mechanics and broad interests in nature.

References

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