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Intermediate-filaments: from disordered building blocks to well-ordered cells. MICHA KORNREICH, ETI MALKA-GIBOR, ADI LASER-AZOGUI, OFER DORON, RAM AVINERY, Tel Aviv University, HARALD HERRMANN, German Cancer Research Center, Heidelberg, ROY BECK, Tel Aviv University — In the past decade it was found that ≈50% of human proteins contain long disordered regions, which play significant functional roles. As these regions lack a defined 3D folded structure, their ensemble conformations can be studied using polymer physics statistical-mechanics arguments. We measure the structure and mechanical response of hydrogels composed of neuronal intermediate filaments proteins. In the nervous system, these proteins provide cells with their mechanical support and shape, via interactions of their long, highly charged and disordered protein chains. We employ synchrotron small-angle X-ray scattering and various microscopy techniques to investigate such hydrogels from the nano- to the macro-scale. In contrast to previous polymer physics theories and experiments, we find that shorter and less charged chains can promote network expansion. The results are explained by intricate interactions between specific domains on the interacting chains, and also suggest a novel structural justification for the changing protein compositions observed during neuronal development. We address the following questions: Can protein disorder have an important role in cellular architecture? Can structural disorder in the micro-scale induce orientational and translational order on the macro-scale? How do the physical properties of disordered protein regions, such as charge, length, and hydrophobicity, modulate the cellular super-structure?

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