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Mechanical nonlinearity in the soft layers of Nacre YUKO AOYANAGI, KO OKUMURA, Ochanomizu University — A number of biocomposites have remarkable hierarchical structures and extraordinary toughness and as such nacre is the most studied biomaterials. Such tough biomaterials always combine soft and hard ingredients and the mechanical responses of the soft elements are quite often nonlinear, while such nonlinearities may originate from some mechanical advantages. In nacre hard sheets are glued by thin soft sheets on submicron scale to form a layered structure. Recently, detailed nonlinear mechanical behaviors of the soft element of nacre have been revealed experimentally. A simple linear model of nacre both in analytical and numerical studies already showed reduction of the stress concentration by existence of soft layers. In this study, in order to explore the importance of the nonlinearity in the soft layers of nacre, we consider a simple nonlinear layered model of nacre. By taking into account the nonlinearity in simulation and scaling models of nacre, we showed that the nonlinearity is essential to reduce stress concentration around crack tips and thus to enhance the strength. Surprisingly, we found that the nonlinearity is optimized both for the strength with avoiding difficulties of the biofabrication of highly nonlinear materials.

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