Femtosecond Laser Processing of Protein Crystals

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It is difficult to process protein crystals by mechanical tools due to their softness and fragility. In this work, the non-contact processing is successfully demonstrated by using multi-photon absorption of focused femtosecond laser beam. We call this technique the femtosecond laser induced cut and cleave operation (fs-CACO). By precisely controlling the laser fluence and the position of the laser focal point, we were able to perform accurate and reproducible processing of hen egg-white lysozyme (HEWL) crystals with little damage in the sealed growth vessels. Using XRD measurements, we confirmed that the processed HEWL crystal retained adequate quality and that there was no deterioration induced by the femtosecond laser irradiation. This technique enables us to process protein crystals without troublesome treatment such as unsealing of the vessels and removal of solutions surrounding the crystals. Fs-CACO procedure will be a powerful tool for making problematic protein crystals suitable for XRD measurements. In the future, this technique could be applied to various processing techniques (e.g., processing protein crystals that overlap each other in the growth vessels or utilizing processed crystals as seeds for protein crystallization).

Keywords: femtosecond laser, protein crystal, laser processing