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Nanometer-Scale Imaging of Collagen Fibers Using Gold Beads

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The 3D spatial position of a particle can be determined by scanning the excitation volume of a 2-photon microscope in a three-dimensional orbit around the particle and by subsequently analyzing the fluorescence intensity profile along the orbit. We track the movement of gold beads moving along collagen fibers by 3D particle tracking method. As the particle moves on the fiber, the particle trajectory maps the substrate with high-resolution (2-20 nm). When the particle moves in close proximity to the collagen, it locally couples and excites to the weak fluorophores on the collagen. This method provides the possibility to characterize the interactions between particle and substrate even further. We can obtain the dynamic structure information of collagen fibers with nanometer resolution in real time. More interestingly, the gold beads move not at random but in specific directions under two photon laser excitation. We were able to move the gold particle very fast along the collagen fibers parallel to the scanning line direction. Based on these results, we can control the velocity and direction of gold beads at our own will.