Scanning probing techniques with a glass capillary have been widely exploited in the characterization of physical, chemical, and biological properties of nano-bio interfaces. Among these techniques, scanning ion conductance microscopy (SICM) has played an essential role in the visualization of live cell surfaces with nanometer-scale resolution. SICM uses an electrolyte-filled glass pipette as a probe to detect an ion current passing through an aperture of the pipette tip. The ion current variation depending on the distance between the pipette tip and sample surface reflects various local information of sample surfaces under a liquid environment, such as geometry, surface charge, and mechanical properties of the sample (Fig. 1). However, a longstanding drawback of SICM is an insufficient spatiotemporal resolution. We have devoted to improve the insufficiency of SICM to realize wide-range applicability of SICM for the investigation of nano-bio interfaces [1-4]. Here we show recent progress of our improvements and applications using our instrument. We developed a tip-scan-type high-speed SICM scanner with a large stroke [1], an active damping control method to reduce unwanted vibrations due to the driving of the scanner [2], and the signal enhancement method with an ion concentration gradient produced in the vicinity of the tip [2]. These improvements allow us not only to visualize dynamic biological processes occurring in soft cell surfaces with high roughness but also to map local mechanical properties of live cell surface.

References