CFRP is a plastic-matrix composite material reinforced by carbon fibers. In our research, we aimed to realize the best performance of CFRP for aircraft use by investigating the relationship between the structure and mechanical properties of CFRP. Firstly, the high resolution characterization of CFRP was obtained by helium ion microscopy (HIM). Figure 1 shows the cross-section of CFRP. The structure of CFRP showed plastic matrix covering the carbon fibers. Typical diameter of carbon fibers was about 7 μm. Then 2D micro-mechanical characterization of CFRP with externally applied stress was performed by confocal Raman microscopy with in-situ bending testing. The Raman spectrum of a carbon fiber is characterized by the presence of two peaks, corresponding to D-band induced by defects and G-band, respectively. Comparing the Raman spectra among them, there was no obvious peak shift after the fracture caused by the bending test. By comparing the peak intensity of D-band with that of G-band, the observed D/G ratio was 90 %, indicating the intrinsic defective property of carbon fibers. In order to clarify the role of interfaces between carbon fibers and plastic matrix, mechanical properties were analyzed by scanning probe microscopy. Figure 2(a) and (b) showed the AFM images of a carbon fiber and matrix surface after AFM nano-indentation. The nanoscale holes formed on the carbon fiber (a) and on the matrix (b) by a diamond AFM tip were found to be enlarged with the increase of applied forces up to ~μN range. Hardness can be approximately evaluated as the loading force divided by the nano-hole area. In this case, the observed hardness of the carbon fiber and the matrix is ~925 MPa and ~42 MPa, respectively.

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