This work investigates modification in the crystalline structure, morphology, and wettability of single-crystal muscovite mica when exposed to oxygen (O_2), carbon tetrafluoride (CF_4), and mixed $O_2 + CF_4$ plasma. The plasma-surface interaction modifies the surface properties of mica, making it more reliable and feasible in nanomanufacturing, electronics, and advanced material applications. X-ray diffraction (XRD) analysis shows significant changes in the crystalline structure of muscovite mica after plasma exposure. The findings demonstrate that the plasma treatment causes substantial structural defects estimated by observing changes in the peak intensities, shift in peak position, reduction in crystallite size, and increase in the microstrain and dislocation density. It is observed that the O_2 plasma induces less structural damage as compared to CF_4 plasma. Whereas, mixed $O_2 + CF_4$ plasma causes excessive structural damage primarily because of the increased density of the reactive ions and radicals. The scanning electron microscopy (SEM) images of plasma exposed mica surface show craters and holes in the case of O_2 plasma treatment at an exposure time of 520 seconds. Whereas, surface exfoliation, pits, and holes are formed when the surface is exposed to CF_4 plasma which is correlated to the etching effect of the heavier reactive plasma species. The surface contact angle of the O_2 plasma exposed mica increases from 47 to 73. On the other hand, the contact angle increased up to 83 when exposed to CF_4 and mixed O_2+CF_4 plasma which suggests that the plasma exposed surface shifts from hydrophilic to hydrophobic owing to the change in surface energy tuned by plasma species. This study explores plasma interaction-induced modification in the mica surface for its potential use in nanomanufacturing and as radiation-facing materials.