An insight into amorphous shear band in magnetorheological solid by atomic force microscope

ABSTRACT

Micro mechanism consideration is critical for gaining a thorough understanding of amorphous shear band behavior in magnetorheological (MR) solids, particularly those with viscoelastic matrices. Heretofore, the characteristics of shear bands in terms of formation, physical evolution, and response to stress distribution at the localized region have gone largely unnoticed and unexplored. Notwithstanding these limitations, atomic force microscopy (AFM) has been used to explore the nature of shear band deformation in MR materials during stress relaxation. Stress relaxation at a constant low strain of 0.01% and an oscillatory shear of defined test duration played a major role in the creation of the shear band. In this analysis, the localized area of the study defined shear bands as varying in size and dominantly deformed in the matrix with no evidence of inhibition by embedded carbonyl iron particles (CIPs). The association between the shear band and the adjacent zone was further studied using in-phase imaging of AFM tapping mode and demonstrated the presence of localized affected zone around the shear band. Taken together, the results provide important insights into the proposed shear band deformation zone (SBDZ). This study sheds a contemporary light on the contentious issue of amorphous shear band deformation behavior and makes several contributions to the current literature.