Polymer composites are multi-phase solid materials with different composition, different shapes, and different properties. Main advantages of polymer composites are their longevity, high strength, light weight, temperature resistance, corrosion resistance, heat insulation, insulation and other properties. According to the purpose of application, polymers and other materials with special properties are selected. Fiber-reinforced epoxy resin (EP) composites refer to new materials that are formed by combining fiber and epoxy resin, which are widely used in buildings, construction, bridges, tunnels, and so on. To meet the demand as structural materials in such applications, high mechanical performances are necessary. Generally high mechanical performances include high strength and modulus, and good impact resistance (or toughness). Due to different textures of epoxy and fiber, their interfacial adhesion is not strong enough to ensure effective load transmission from the matrix to the fibers. Thus, novel and efficient modification methods are required to improve mechanical properties of EP/fiber composites. Moreover, the application of EP composites has been badly limited due to its high flammability. As we know, EP composites can be easily ignited and thereby produces large amount of heat and smokes, which are the main reasons for permanent injury and death in fire accidents. So, it is of great significance to reduce the production of heat and smokes of EP resin when fire occurs. In other words, flame retardance modification of EP composites is a pressing need.

To improve the flame retardancy of polymer materials, the most common method is physically addition of flame retardants, but in the majority of cases high-loading of flame retardants that are not easily dispersed results in the deterioration of mechanical properties. The current challenge for scientists who carry out research in the field of EP/fiber composites is to develop favorable methods for synchronously improving their mechanical properties and flame retardancy. Within the project, a green and environmentally friendly method will be developed to modify fibers for fabricating high performances EP/fiber composites. Firstly, various fibers (glass fiber, carbon fiber, natural fibers, *etc*.) will be coated with active nanoparticles (SiO_2, TiO_2, $Zn(OH)_2$, $Mg(OH)_2$, *etc*.), then high-effective phosphorus-containing flame retardant will be grafted onto fiber surfaces. On the one hand, the coated nanoparticles with active groups on fiber surfaces will increase the amount of grafted phosphorus-containing flame retardants, which are effective in improvement of the flame retardancy. On the other hand, part of retained active groups will enhance the interaction of EP matrix and fibers via hydrogen-bond, resulting in the improved mechanical properties.