In this research, the characteristics of aluminum oxide nano-particles (nano-Al$_2$O$_3$), acting as a catalyst and co-catalyst with sodium hypophosphite (SHP) in the wrinkle-resistant finishing of cotton fabric with 1, 2, 3, 4-butanetetracarboxylic acid (BTCA), were examined. Surface morphology and chemical compound of the fabrics together with the wrinkle-resistant, flame retardant, yellowing, air permeability and tensile strength properties were also evaluated. Scanning Electron Microscopy and Energy Dispersive X-ray microanalysis proved the change in fabric morphology and the presence of nano-Al$_2$O$_3$ on the fabric surface. It was also found that cross-linking of cotton cellulose with BTCA catalyzed by nano-Al$_2$O$_3$ or SHP in the presence of nano-Al$_2$O$_3$ co-catalyst was carried out. In addition nano-Al$_2$O$_3$ added in the wrinkle-resistant treatment could act as a multifunctional finishing agent to improve the flame retardant property as it ensures decreasing the yellowness of the fabric. Therefore, nano-Al$_2$O$_3$ could enhance the finishing performance and minimize the side effect.