In this research, using aluminum oxide nano-particles (Al$_2$O$_3$-NPs) as a catalyst and co-catalyst in the wrinkle-resistant (WR) finishing of cotton fabric with 1,2,3,4-butanetetracarboxylic acid (BTCA), was investigated. For this, cotton fabrics were cross-linked with BTCA catalyzed by Al$_2$O$_3$-NPs or SHP in the presence of Al$_2$O$_3$-NPs as co-catalyst. Surface morphology and chemical composition of the treated fabrics beside the fabric properties such as the wrinkle-resistant, flame retardant, yellowing, and air permeability were also evaluated. SEM and EDX microanalysis proved the presence of Al$_2$O$_3$-NPs on the fabric structure. The cross-linking of the fabrics with BTCA catalyzed by Al$_2$O$_3$-NPs or SHP was identified by FT-IR spectroscopy. The fabric test results indicated that the Al$_2$O$_3$-NPs co-catalyst could act as a multifunctional finishing material. The flame retardant property of the fabric besides WR was improved. It was also concluded that Al$_2$O$_3$-NPs could enhance the finishing performance and minimize the side effect of SHP.