Bi<sub>2</sub>Te<sub>3</sub> nanowires are promising candidates for thermoelectric applications. In this study, we compare nanowires fabricated by a Gold-catalyzed growth method with an alternative method using titanium dioxide. We observe that the latter approach results in nanowires with a crystal structure of nearly perfect quintuple layers. Surprisingly we find only a negligible effect on their thermoelectric properties, namely electrical conductivity and Seebeck coefficient. This maybe relevant for further optimization and engineering of thermoelectric nanomaterials for device applications.