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We have investigated anisotropic current transport properties in a thick YBCO tape under high magnetic fields up to 27 T. A 2.9 μm thick YBCO layer was formed by the ex-situ process on an bi-axially aligned YSZ-IBAD/Hastelloy substrate. Electric field vs. current density (E-J) characteristics of the tape have been measured by the four probe method at broad conditions of temperature and magnetic field parallel and perpendicular to the tape surface. In addition to the J_c-B properties, statistic Jc distribution was estimated from the measured E-J characteristics within the framework of the percolation model. Analytical expression for the nonlinear E-J characteristics in parallel and perpendicular magnetic field have been derived as a function of temperature and magnetic field based on the percolation model and the scaling analysis of the magnetic field dependence. The accuracy of the computational modeling has been verified experimentally. Namely, the formulation allows us to describe the complicated E-J characteristics precisely at various conditions of temperature and magnetic field. This work was partly supported by the New Energy and Industrial Technology Development Organization (NEDO) as US-Japan collaboration project on ac-loss study of HTS conductor.