Rolling contact mechanics of graded coatings involving frictional heating. (English)

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Summary: The two-dimensional thermoelastic tractive rolling contact problem for a half-plane which is coated with a functionally graded material (FGM), under the plane strain deformation, is studied in this paper. A rigid cylinder rolls over the surface of an FGM coating with constant translational velocity, generating frictional heating in the slip zones of the contact area. Thermomechanical properties of the FGM vary exponentially along the thickness direction. It is assumed that the contact area consists of a central stick zone and two slip zones of the same sign. The transfer matrix method and Fourier integral transform technique are used to achieve a system of two Cauchy singular integral equations. The coupling effect of tangential traction is eliminated by adapting the conventional Goodman approximation. The associated governing equations are discretized by applying the Gauss-Chebyshev integration method gaining a system of linear algebraic equations. The effects of Peclet number, material properties’ grading ratios and friction coefficient on surface and in-plane stresses, stick zone boundaries and surface temperature distribution are studied.

MSC:
74M15 Contact in solid mechanics
74M10 Friction in solid mechanics
74F05 Thermal effects in solid mechanics
74E30 Composite and mixture properties

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References:


