PyRolL Misaka flow stress Plugin

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May 22, 2023

This plugin provides the implementation of the constitutive equation from Misaka and Yoshimoto [1] to calculate the flow stress of low alloyed carbon steels.

1 Model approach

The model equation 1 was derived from flow stress measurements. Those have been conducted by the author who used hammer drop tests to investigate the flow stress of several low alloyed carbon steels. The model equation takes into account the strain ϵ, strain rate $\dot{\epsilon}$, absolute temperature T as well as the carbon content C of the material.

$$k_{\mathrm{f,m}} = \exp\left(0.126 - 1.75C + 0.594C^2 + \frac{2851 + 2968C - 1120C^2}{T}\right)\epsilon^{0.21}\dot{\epsilon}^{0.13} \tag{1}$$

The equation is valid for strains of up to 0.5, temperatures between 750 °C and 1200 ° °C and strain rates of $30\,\mathrm{s}^{-1}$ to $200\,\mathrm{s}^{-1}$. The maximum carbon content is 1.2 weight percent.

2 Usage instructions

The plugin can be loaded under the name `pyroll_misaka_flow_stress`. The plugin defines the hooks

Table 1: Hooks specified by this plugin.

Hook name	Meaning
`flow_stress`	Flow stress of the material
`flow_stress_function`	Flow stress as a function of the strain

References

[1] Y. Misaka and T. Yoshimoto. "Formularization of Mean Resistance to Deformation of Plain Carbon Steels at Elevated Temperature". In: *J. JSTP* 8.79 (1967).