Mathematical modeling of the fast pulse-heating experiment as applied to ruthenium

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The rapid pulse heating technique is based on heating the conductor while passing a large current pulse. An experimental facility allows fast heating of the metal samples from room temperature up into the liquid phase in typically 100 μs. In the present paper, the current in the electrical circuit, voltage on the sample with correction of the inductive contribution and temperature of the pulse-heated wire were calculated analytically.

For numerical simulation, an electric discharge circuit with an *RLC* circuit and a variable sample resistance was used. The discharge process is described by two systems of differential equations with written based on the Kirchhoff law and equations of the dependence of resistance on temperature for the beginning and end of the pulse. To solve the equations, the Runge–Kutta method of the forth order in the Matlab system is used.

As a result of numerical simulation, the dependence of the current, voltage and temperature of the sample on time was obtained depending on the parameters of the discharge circuit—discharge capacitance, voltage, additional resistance, circuit inductance and sample properties (in particular, ruthenium). The simulation results are compared with the experimental data.

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