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FRICTION WELDING OF PIM HEAT-RESISTANT STEEL TO STEEL 40Kh

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Experimental data are given on evaluation of structure of heat-resistant steel AISI310 produced by the powder injection moulding technology. The investigation results are presented on peculiarities of formation of dissimilar joints between steel AISI310 and structural steel 40Kh under different thermal-deformation cycles of friction welding in manufacture of bimetal shafts for automotive engine turbocharger rotors.

Keywords: *friction welding, bimetal joints, powder injection moulding, welded joints, turbocharger rotor shafts*

One of the new powder metallurgy methods is powder injection moulding [1–5], which in the English technical literature is collectively known as the PIM-technology. Powder injection moulding has been gaining an increasingly wider acceptance in the last years owing to a number of advantages over traditional methods of metal processing, first of all in manufacture of complex-geometry and mass-production parts. According to the data given in [3], density of the finished parts produced by the PIM-technology is 96 to 100 % of its theoretical value, while the detected pores and non-metallic inclusions have small sizes and a spherical shape, and are uniformly distributed in the bulk.

The promising market for the parts produced by the PIM-technology is the automotive engine construction industry. The issue of current importance in terms of technology and economy is application of the PIM-technology to manufacture complex-configuration parts. For example, these are wheels of bimetal shafts for automotive engine turbocharger rotors (TCR). Compared to the currently applied investment casting method, the PIM-technology provides an increased productivity, minimal possible deviations of sizes and a high quality of the surface of the wheels for the TCR shafts.

The technological cycle of manufacture of the bimetal TCR shafts provides for the use of friction welding (FW) of a heat-resistant alloy wheel to a structural steel shank. Friction welding is applied to advantage to join materials produced by the casting, thermo-mechanical deformation and powder metallurgy methods [6–8]. However, no information on application of FW for the parts produced by the PIM-technology has been found in technical literature so far. Therefore, it is of scientific and practical interest to study the effect of structure of the PIM-materials on the possibility of joining them to structural steel to manufacture bimetal TCR shafts.

The purpose of this study was to investigate formation of dissimilar joints between heat-resistant steel AISI310 produced by the PIM-technology and structural steel 40Kh under different thermal-deformation cycles of FW for manufacture of bimetal TCR shafts.

General view of the TCR shaft wheels made by the PIM-technology from steel AISI310 (feed stock — BASF «Catamold» [3]) is shown in Figure 1. Chemical composition of the materials welded, as well as their mechanical properties are given in the Table.

Austenitic stainless steel AISI310 (domestically produced analogue — steel 20Kh25N20S2 (EI283)) combines satisfactory heat resistance and high oxidation resistance at high temperatures. Bimetal TCR shafts were produced by join-

Chemical composition and mechanical properties of materials welded

Steel grade	Content of elements, wt.%							Mechanical properties			
	C	Cr	Nb	Si	Mn	Fe	Ni	σ_y, MPa	σ_t, MPa	δ, %	ψ, %
AISI310	<0.2	24–26	<0.2	1.5–2.0	1.0–1.4	Base	18–21	>205	>515	>40	>50
40Kh	0.36–0.40	0.8–1.1	–	<0.35	0.5–0.8	Same	<0.3	>720	>860	<14	<60