HUGONIOT AND SOUND VELOCITY PRESSURE DEPENDENCE IN SAMPLES OF REACTIVE MIXTURES OF NICKEL AND ALUMINUM POWDERS OF DIFFERENT DISPERSITY

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THE AIM OF THE WORK AND THE METHOD OF RESEARCH

Aim of the work:

Investigation of the Ni+Al system capability to react in submicrosecond time scale at shock compression.

Method of research:

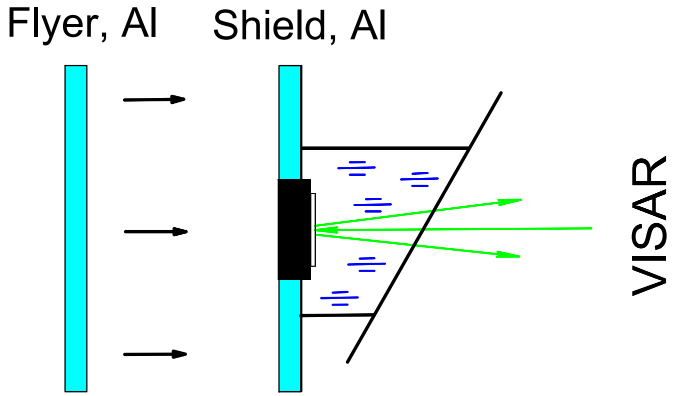
Method of overtaking rarefaction wave with the use of laser interferometer VISAR.

SAMPLES

Samples: of nanomixture – on left, of micromixture – on right.

Mixture type	NANO	MICRO
Dispersity	Ni-80 nm; Al-100 nm	Ni-20 μm; Al-2x100 μm
Composition	Ni/Al – 68,5/31,5 wt. %	
Pressing force	8,5 ton/cm^2	6,5 ton/cm^2
Диаметр	40,2 mm	
Diameter	3-9 mm	
Density	3,87 ± 0,02 g/cm^3	
Porosity	25 ± 0,3 %	

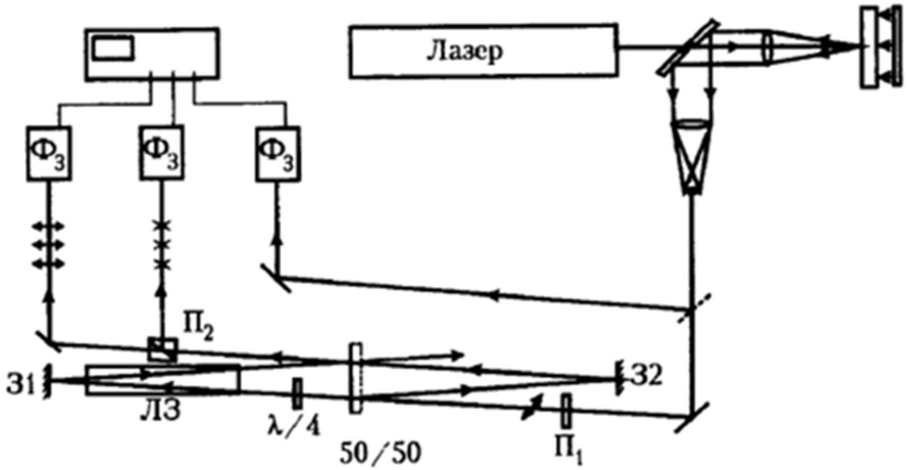
EXPERIMENTAL TECHNIQUE



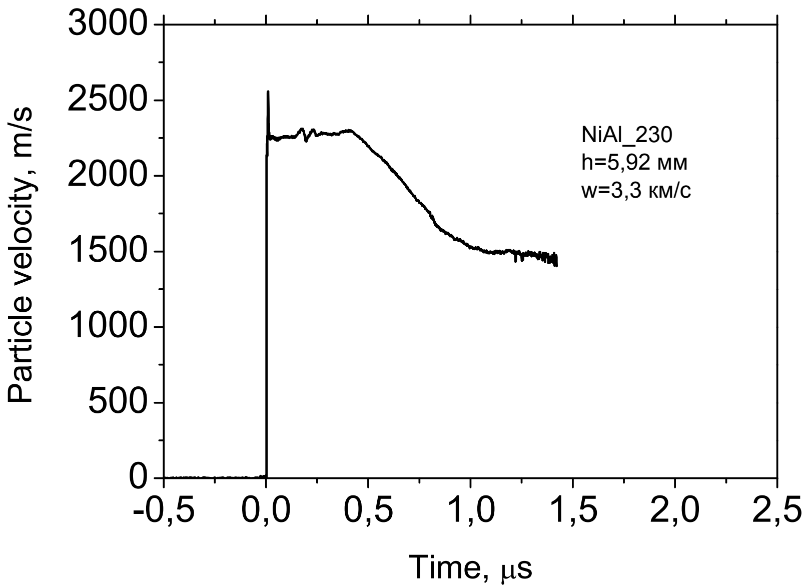
Scheme of the experiment

$v_{уд}$ = 1,4 km/s

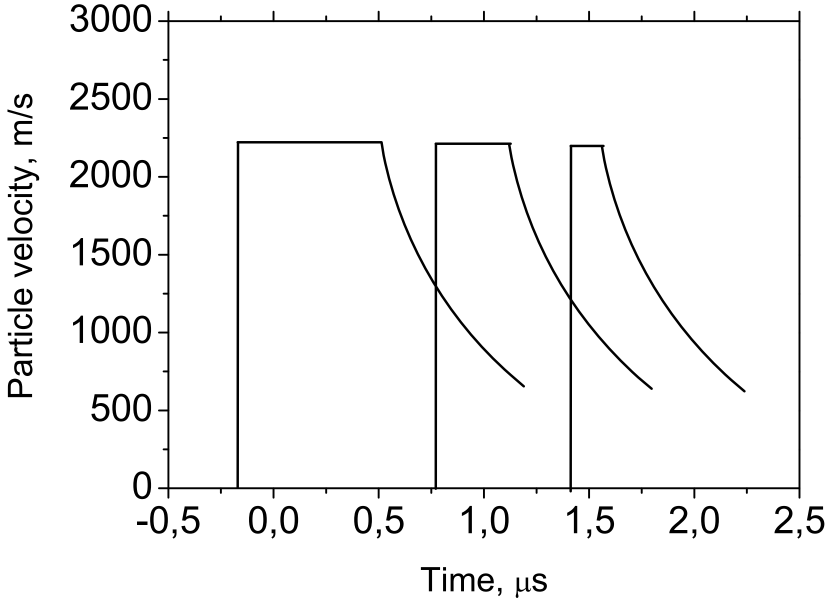
$v_{уд}$ = 3,3 km/s



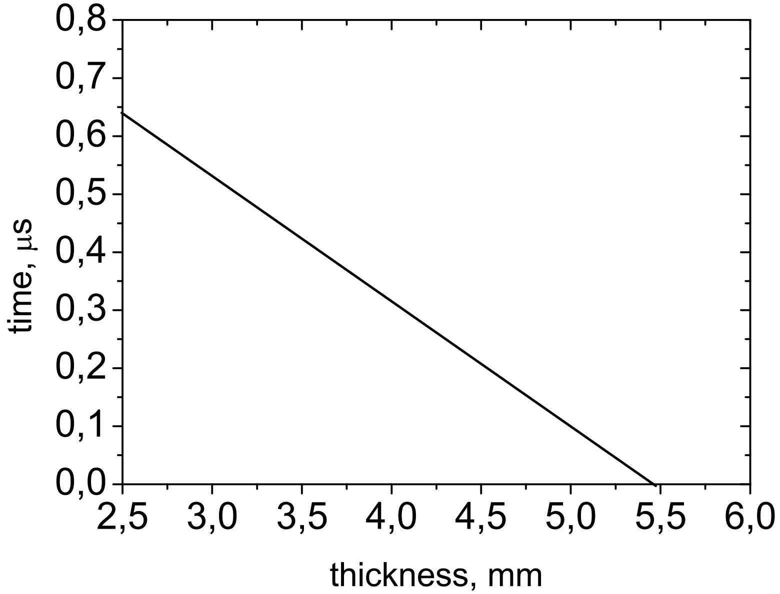
Scheme of laser interferometer VISAR



METHOD OF OVERTAKING RAREFACTION WAVE

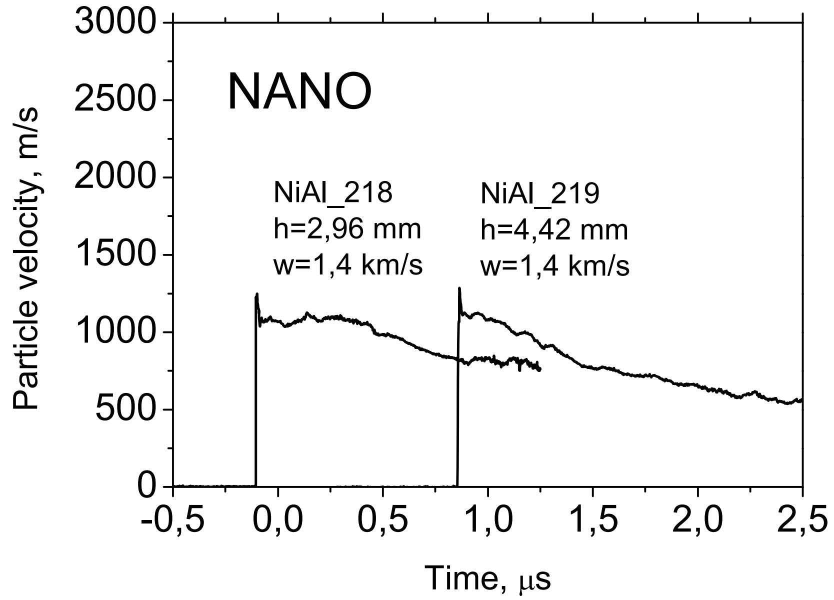


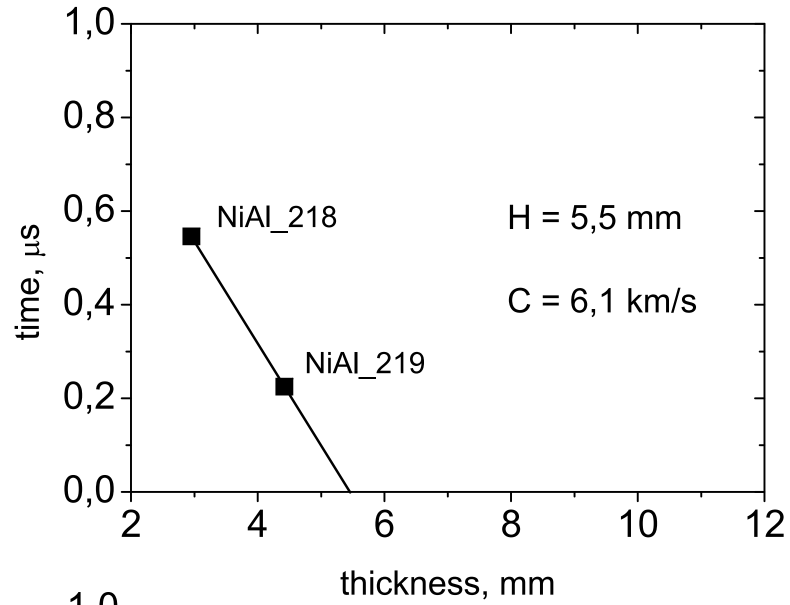
$$C_{обр} = \frac{HC_{уд}D_{уд}(D_{обр} - u_{гр})}{HC_{уд}D_{уд} - h_{уд}D_{обр}(C_{уд} + u_{гр} + D_{уд} - v_{уд})}$$

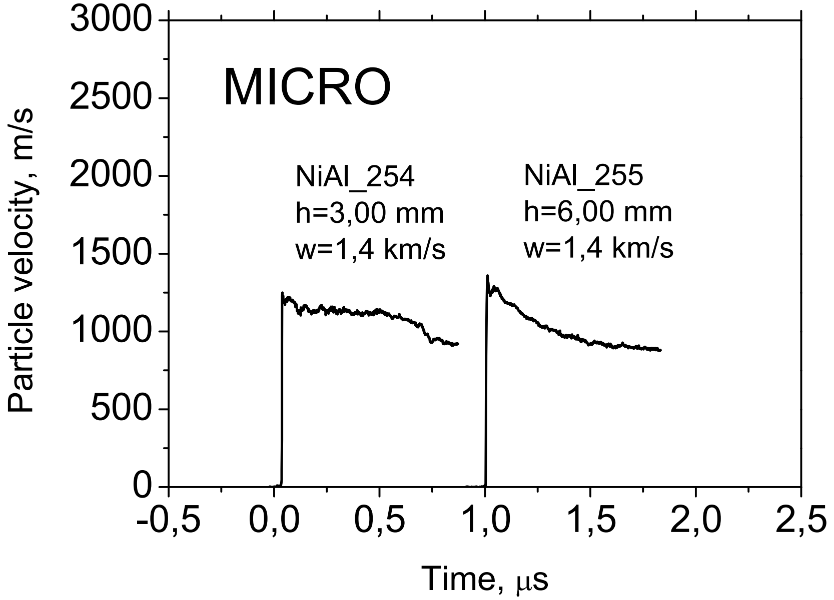


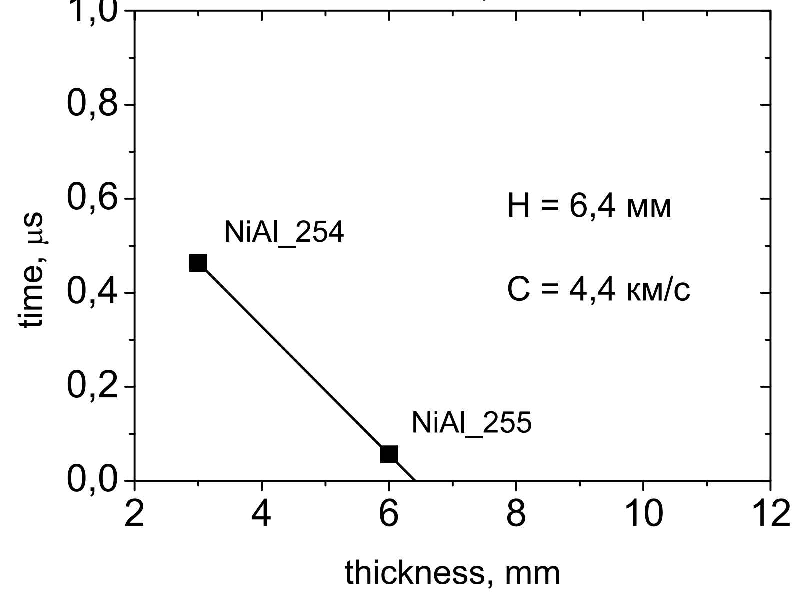
H – thickness of the sample at which rarefaction wave overtakes shock wave,
$D_{уд}$ – shock wave velocity in flyer,
$C_{уд}$ – sound velocity in flyer at given pressure,
$D_{обр}$ – shock wave velocity in sample (found in experiments for Hugoniot measurement),
$u_{гр}$ – velocity of the boundary flyer-sample,
$h_{уд}$ – flyer thickness,
$v_{уд}$ – velocity of the flyer.

RESULTS OF EXPERIMENTS AT P = 10 GPA

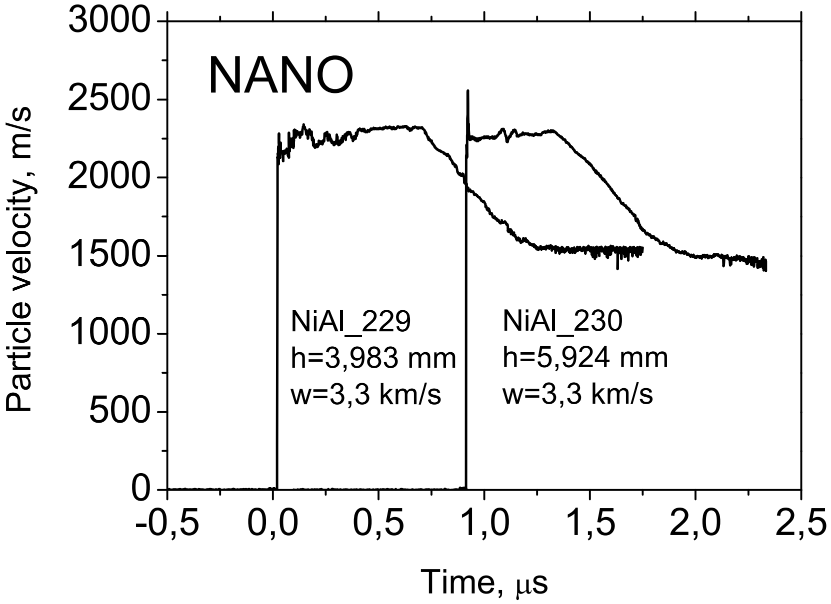


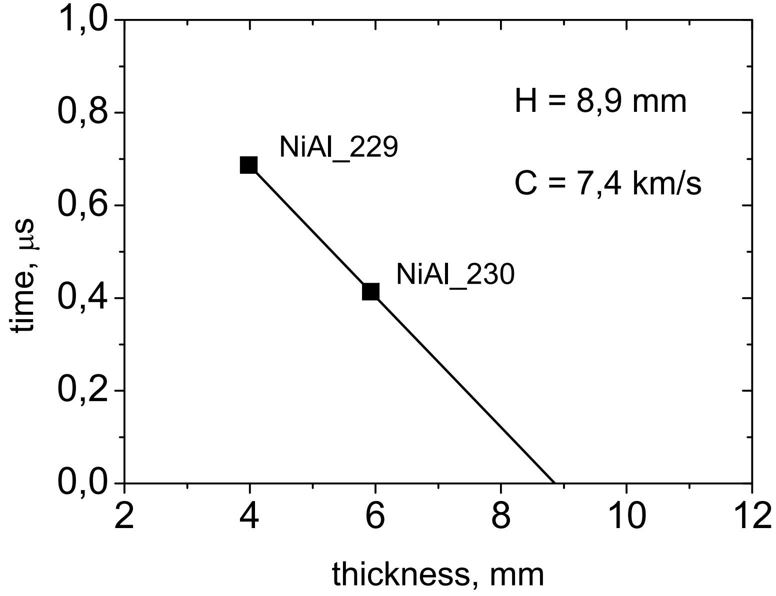


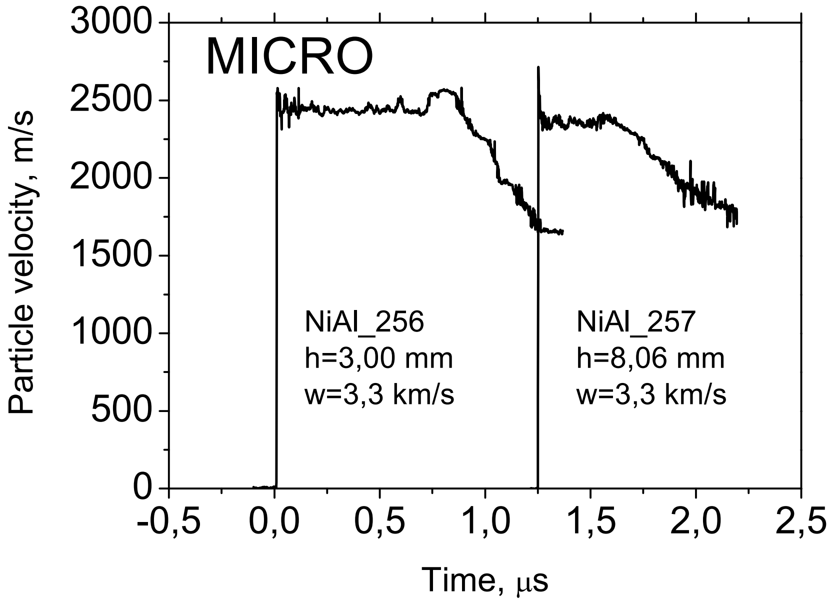


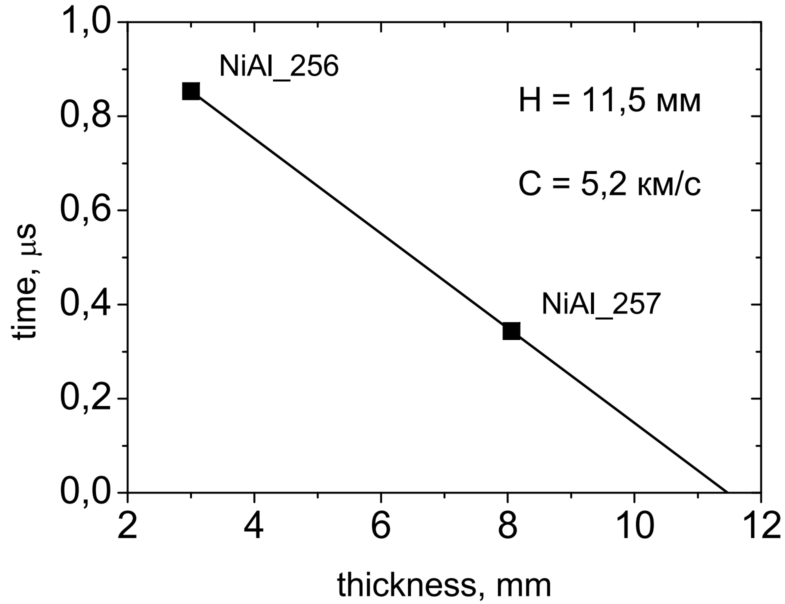


RESULTS OF EXPERIMENTS AT P = 31 GPA

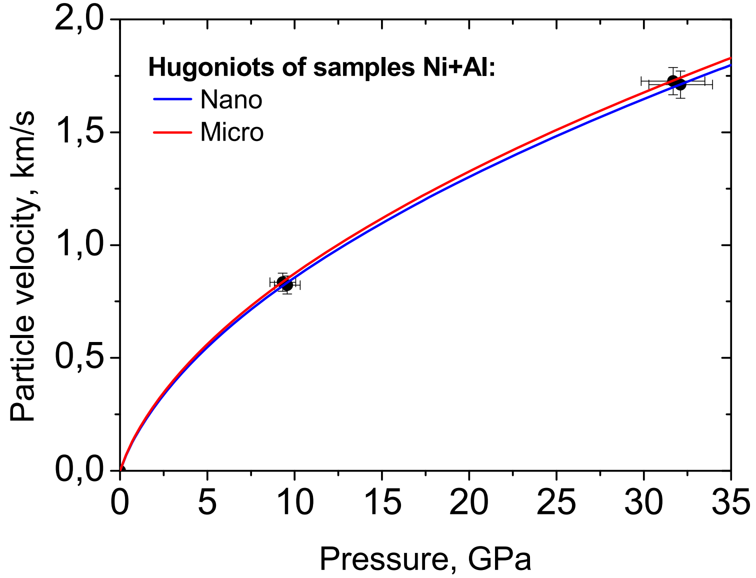


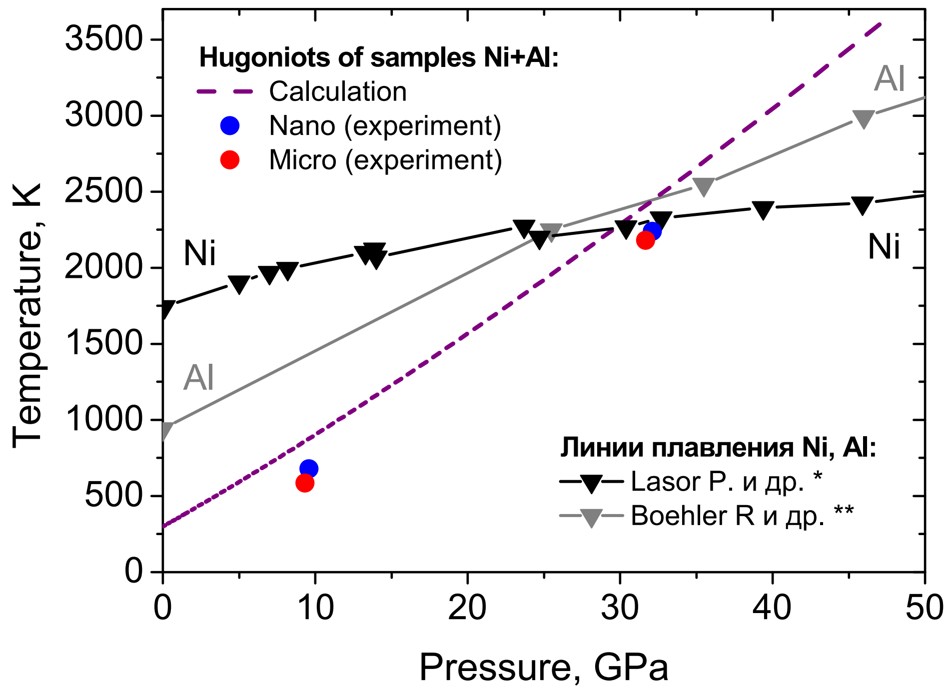


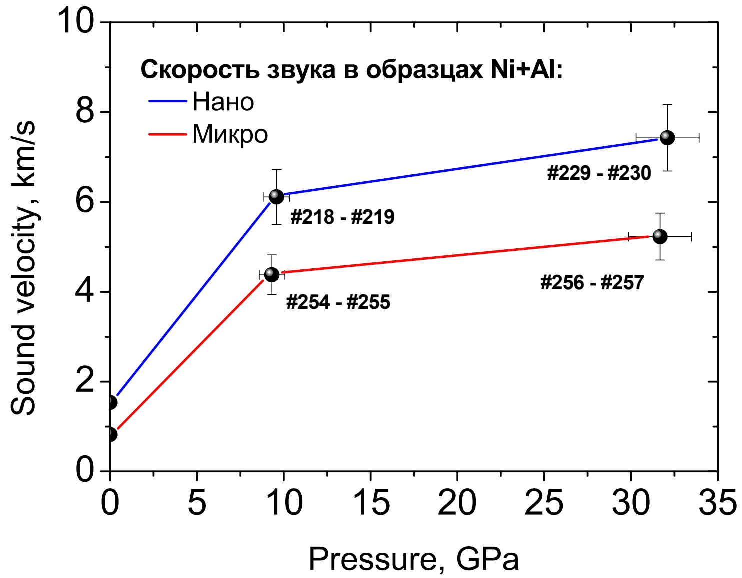




DISCUSSION OF RESULTS



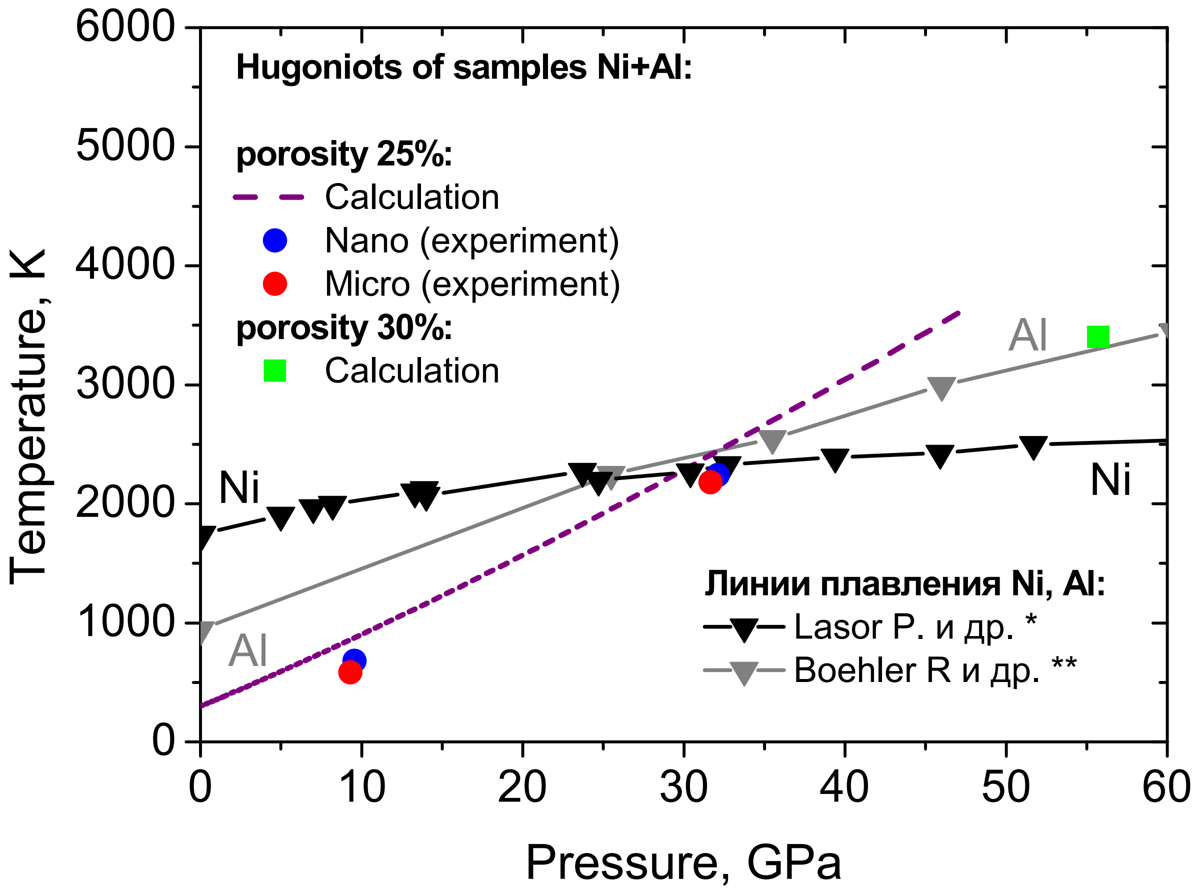




*) Lazor P., Shen G., Saxena S. K.
Laser-heated diamond anvil cell experiments at high pressure: Melting curve of nickel up to 700 kbar. //Physics and Chemistry of Minerals. – 1993. – Т. 20. – №. 2. – С. 86-90.

**) Boehler R., Ross M.
Melting curve of aluminum in a diamond cell to 0.8 Mbar: implications for iron . //Earth and Planetary Science Letters. – 1997. – Т. 153. – №. 3-4. – С. 223-227.

EVALUATION OF THE ABILITY OF GETTING INTO MELTING AREA



CONCLUSIONS

• It is shown that below melting point ($P<31$ GPa) sound velocities in shock loaded samples of nano- and microdispersed nickel and aluminum powder mixtures differ markedly which is connected with the difference of mechanical properties of the mixtures.

• Loading parameters for getting into the melting area of both components are evaluated. It can be expected that these conditions will be eliminated the difference in mechanical properties of the mixtures that will create better conditions for the detection of the reaction.