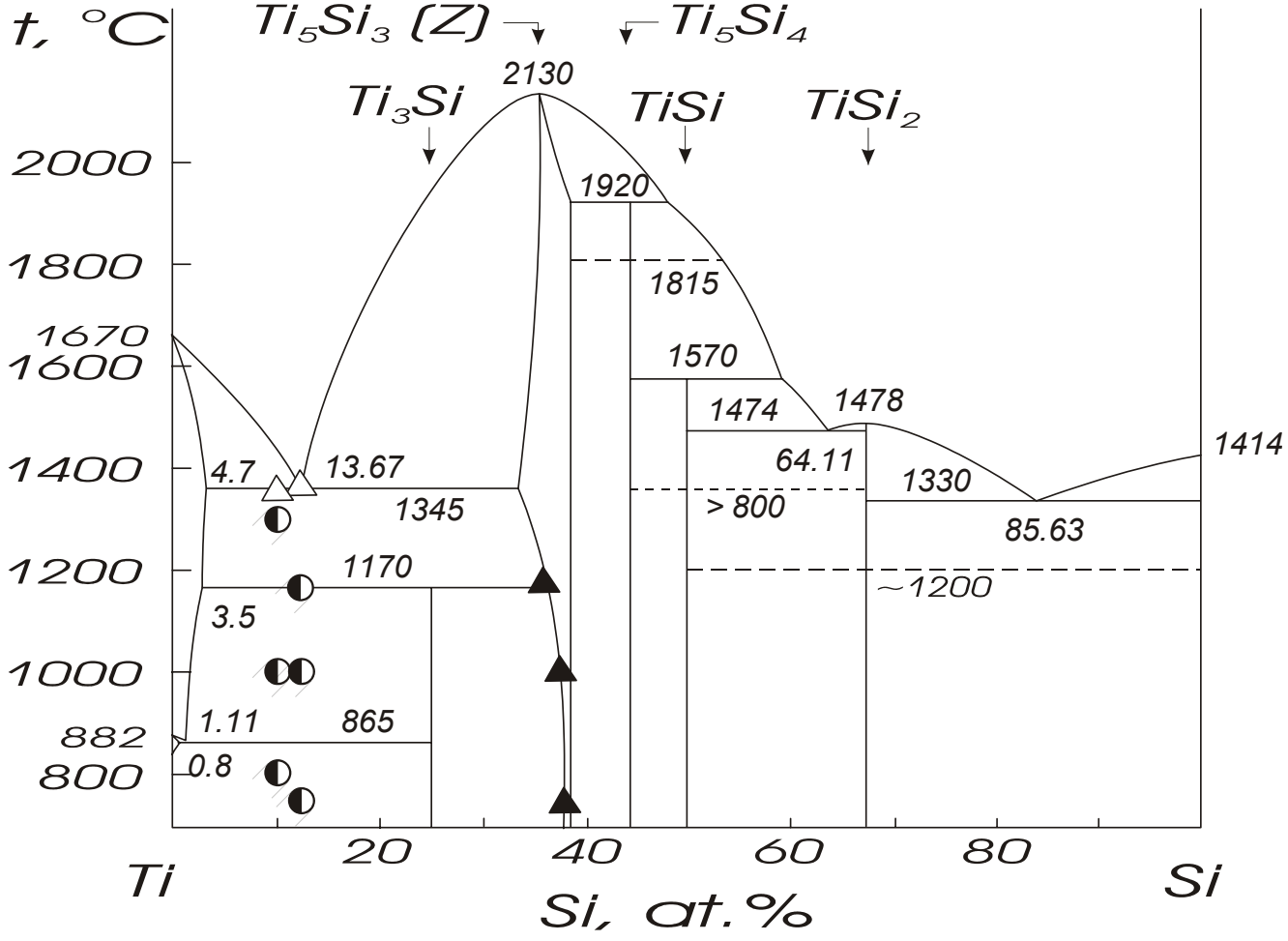
MULTICOMPONENT Ti-Si-BASED SYSTEMS

or

PHASE RELATIONSHIPS AND PROPERTIES OF MULTICOMPONENT Ti-Si-BASED ALLOYS AS FUNDAMENTAL BACKGROUND FOR ELABORATION OF HIGH-TEMPERATURE TITANIUM MATERIALS

M.Bulanova, S.Firstov, L.Kulak, D.Miracle, L.Tretyachenko and T.Velikanova



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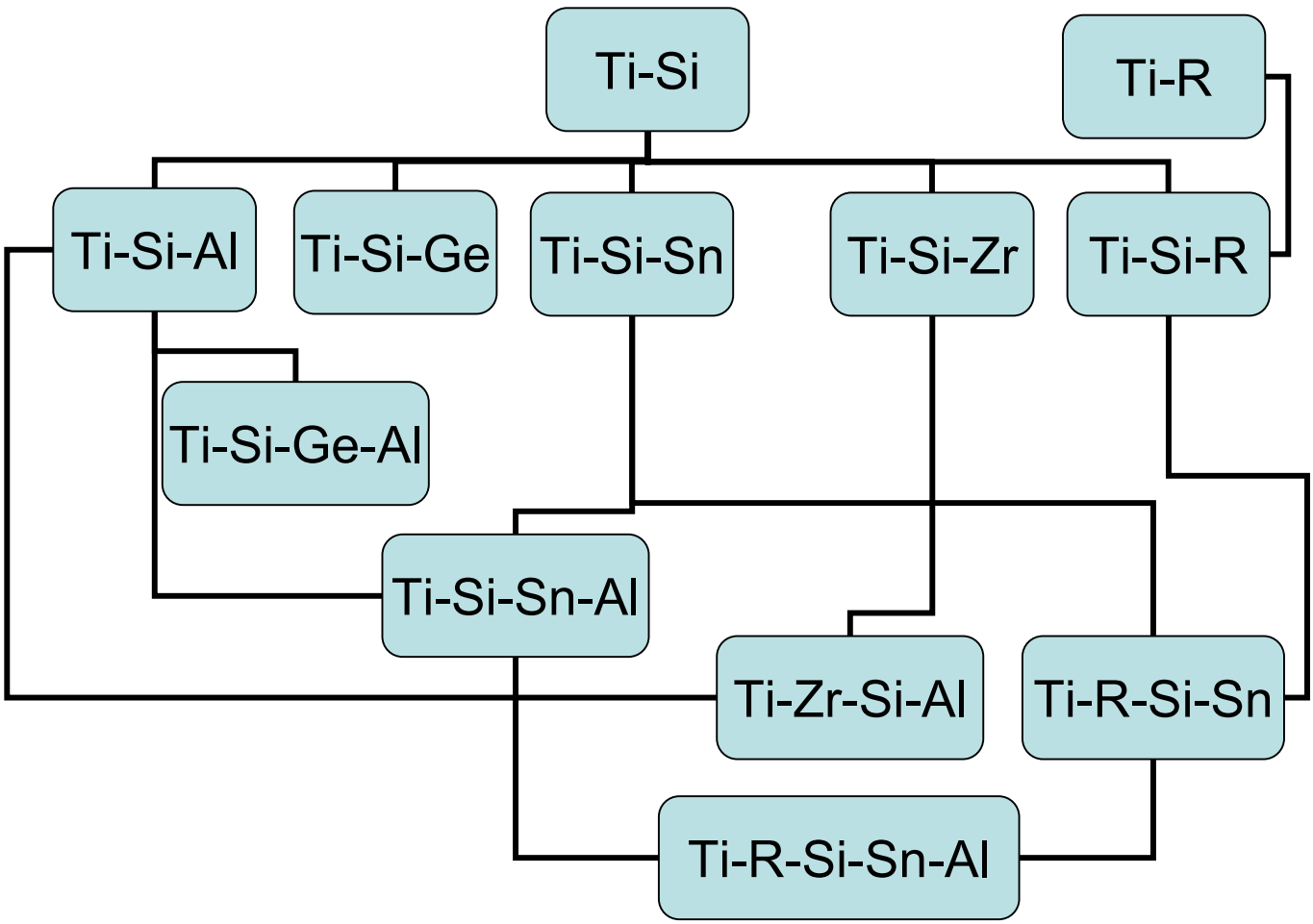
Scheme of the presentation



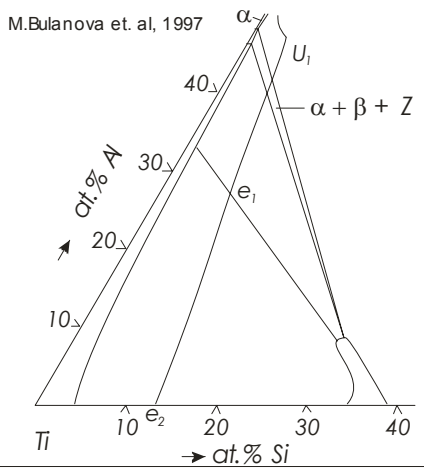
- Homogeneity ranges of the phases
- Eutectics:

  extension of the binary eutectic into the multicomponent system

  *search for new **binary** and **ternary** eutectics*
- Phase relationships in the solid state
- Links phase diagram - property

Ti-corners of Ti-Si-p-element melting diagrams

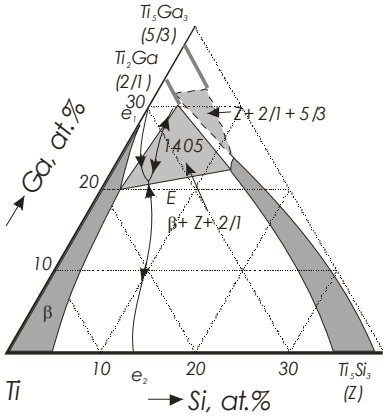
M.Bulanova et. al, 1997



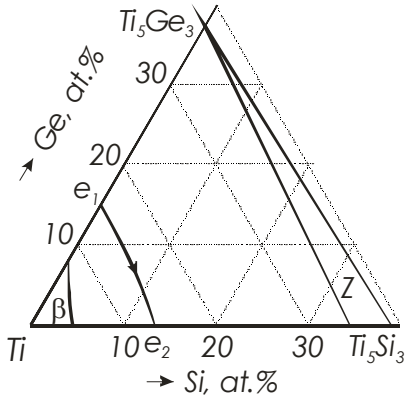
Two tendencies

1. Crystal structure of 5/3 binary intermetallics
2. Difference in atomic radii op the p-elements

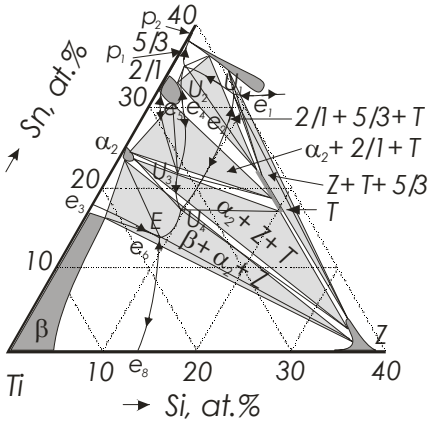
N.Antonova et. al, 1998



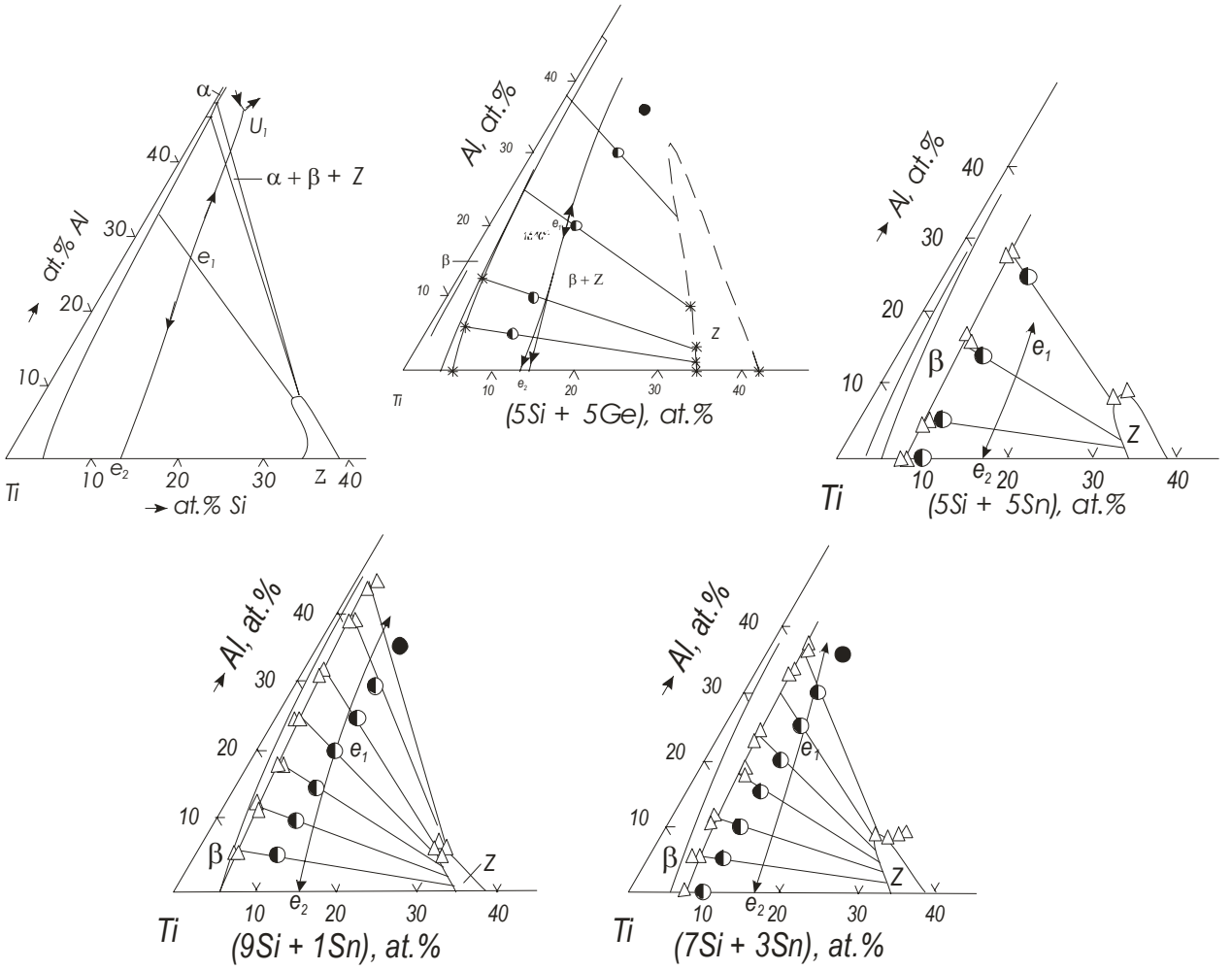
Our prognosis



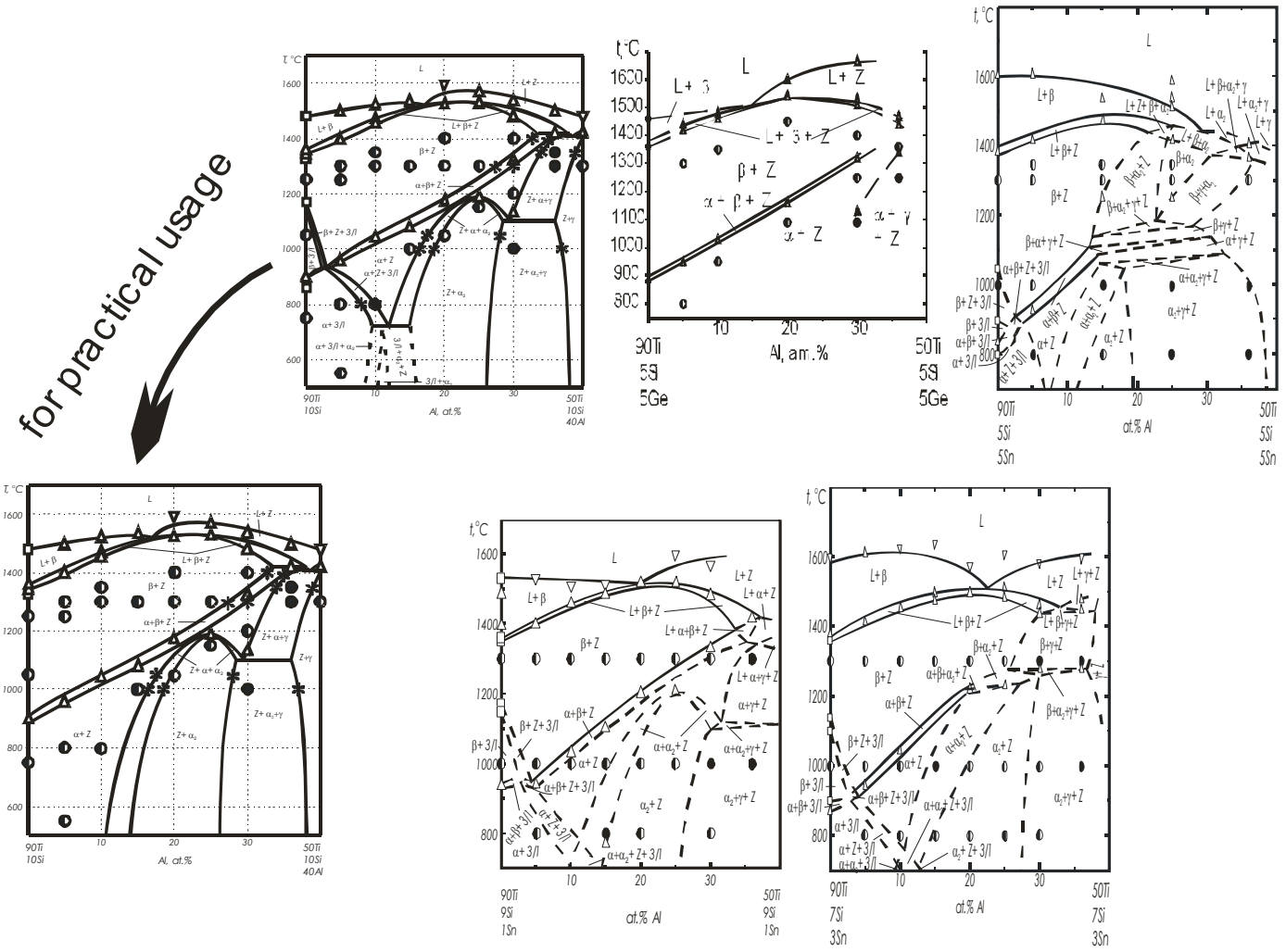
M.Bulanova et. al, 2002, to be published



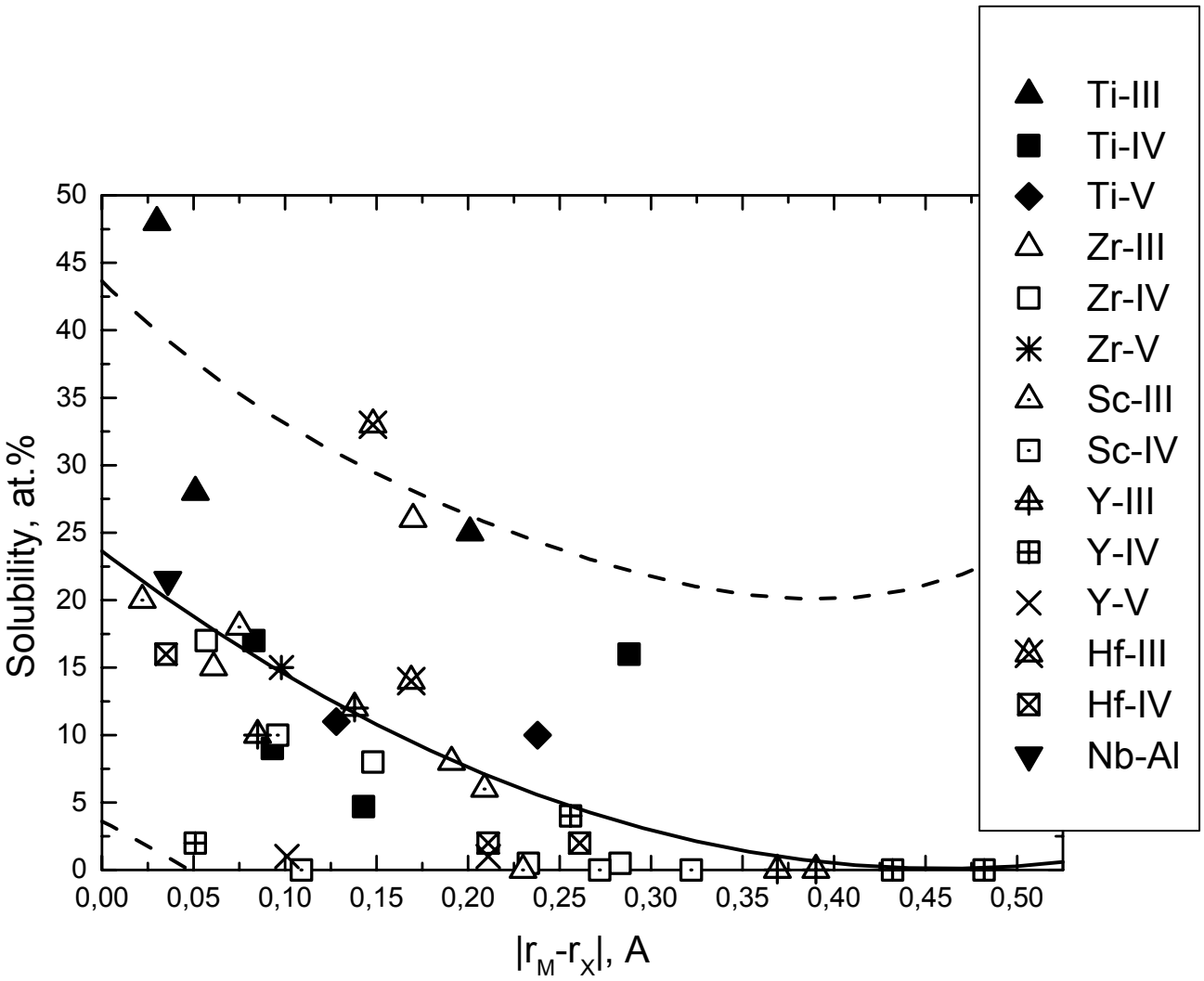
Melting diagrams of Ti- corners of Ti-Si-Al-p-element systems



Isopleths of Ti-corners of Ti-Si-Al-p-element systems



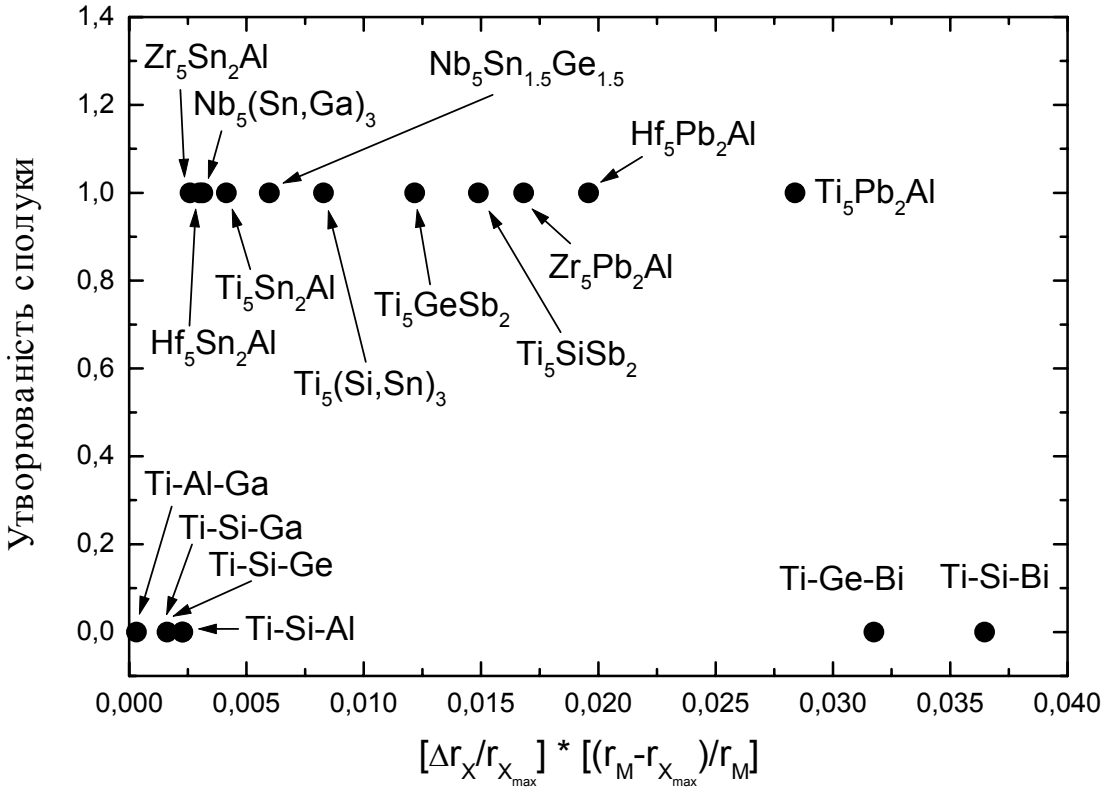
Maximum solubility of *p*-elements in *d*-metals



Formability of the 5/3 ternary compounds with the W_5Si_3 structure type

$$F = [\Delta r_X / r_{Xmax}] * [(r_M - r_{Xmax})/r_M]$$

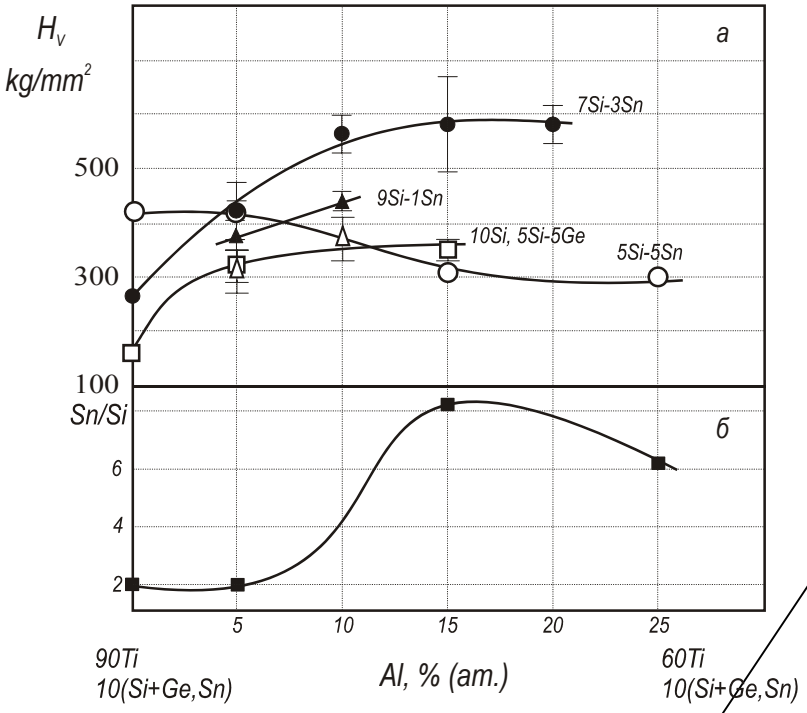
Δr_X – difference of the atomic radii of *p*-elements,
r_{Xmax} – atomic radius of the larger *p*-element atom,
r_M – atomic radius of *d*-metal.

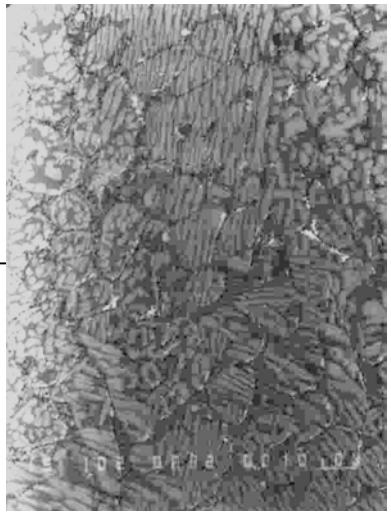


$0.023 < F < 0.032$.

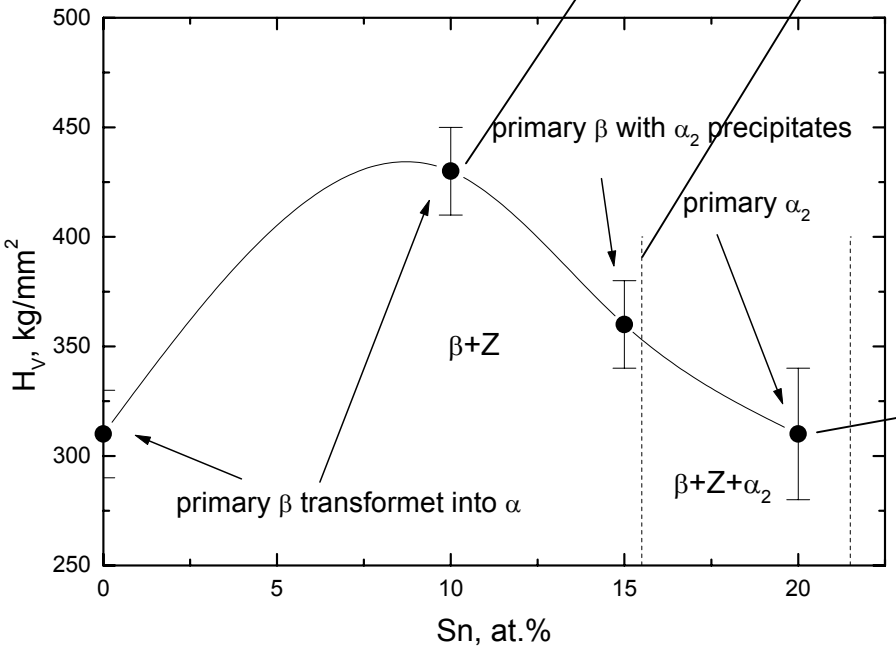
Microhardness of Ti-matrix

M.Bulanova et. al, 1998, 2000

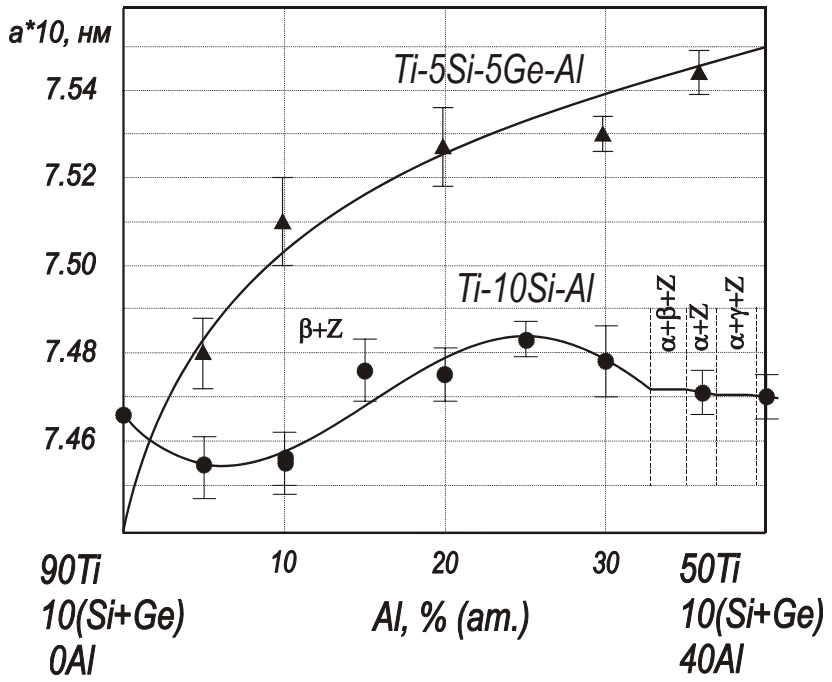


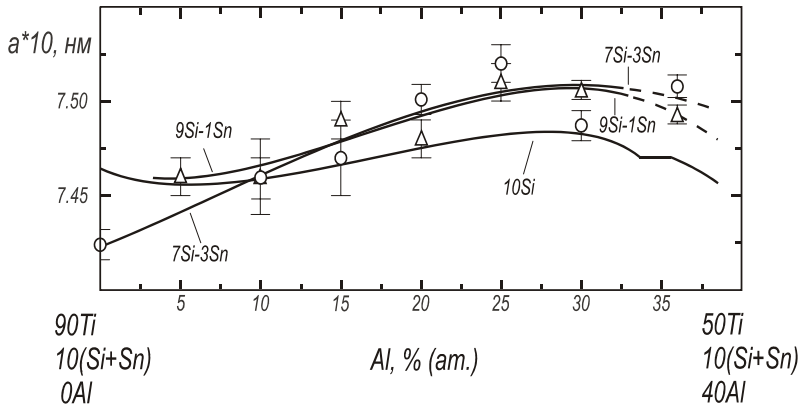


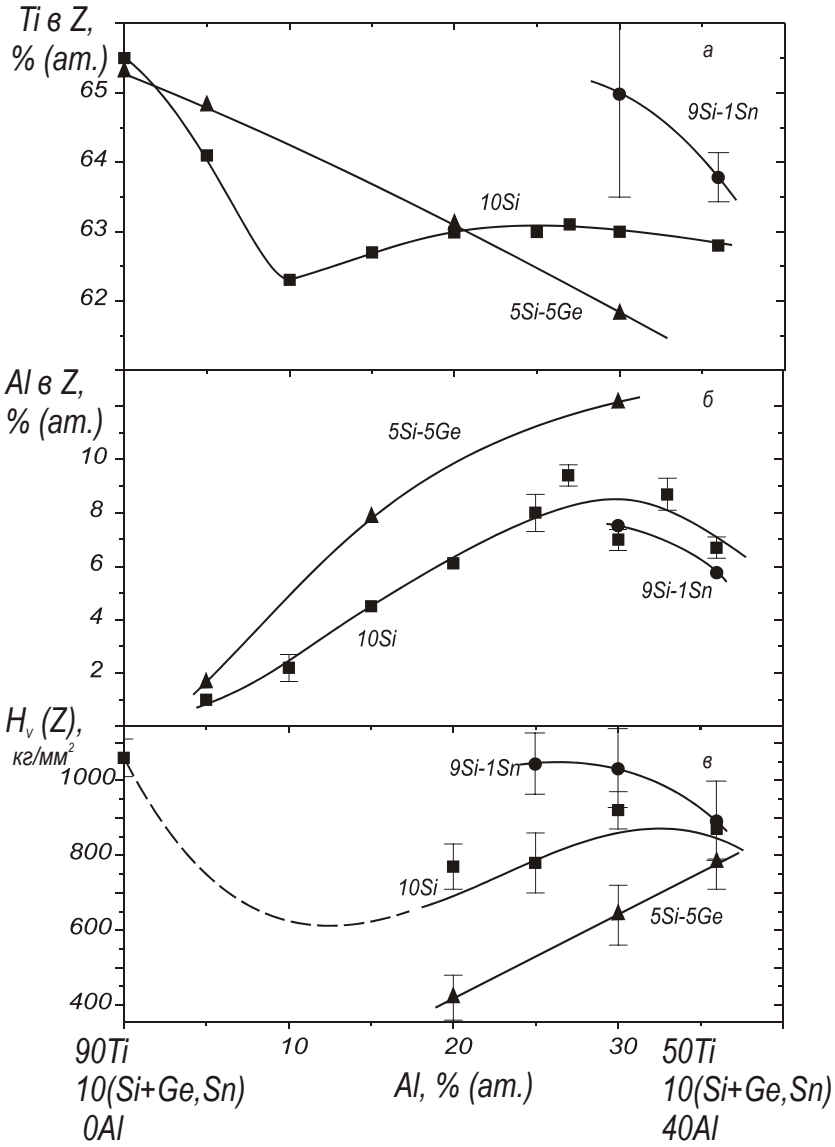
M.Bulanova et al., 2003



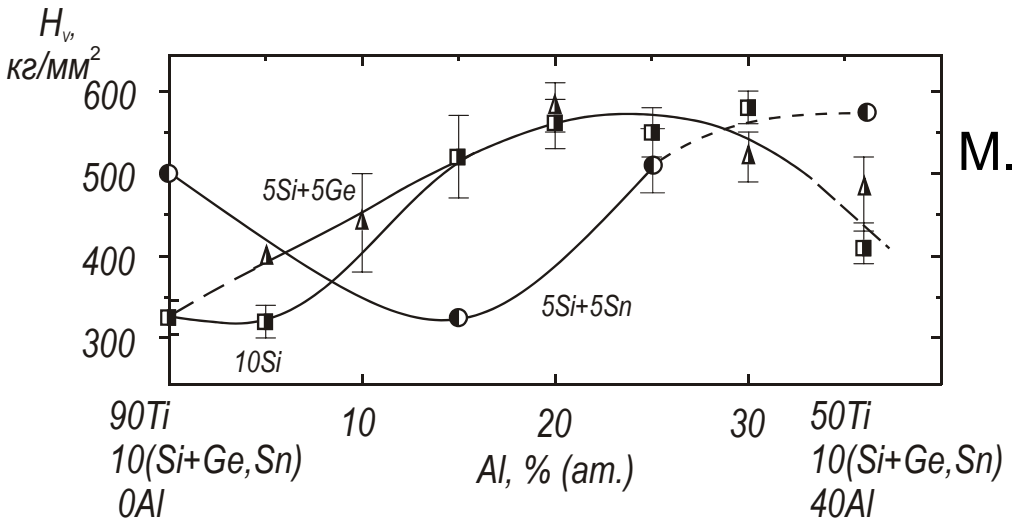
Lattice spacings and microhardness of the primary Z



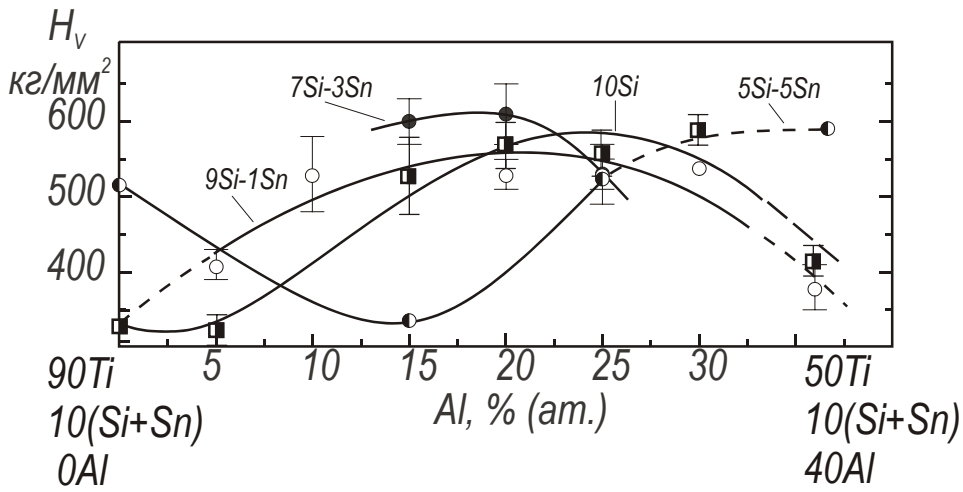


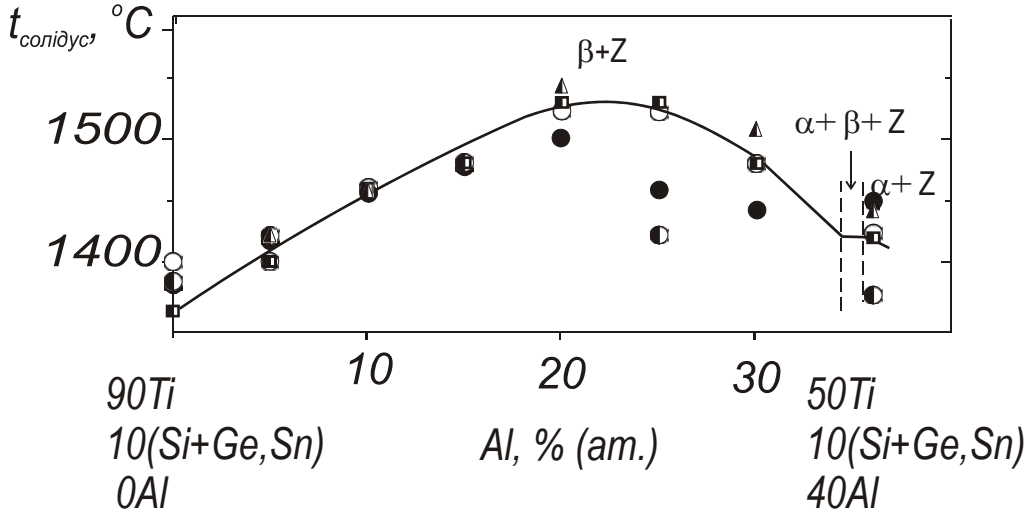


Correlation of microhardness of eutectic mixtures with the solidus temperatures



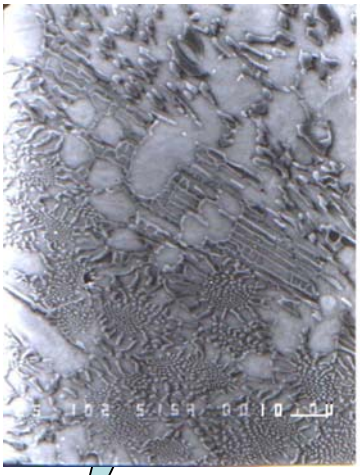
M.Bulanova et. al, 1998, 2000

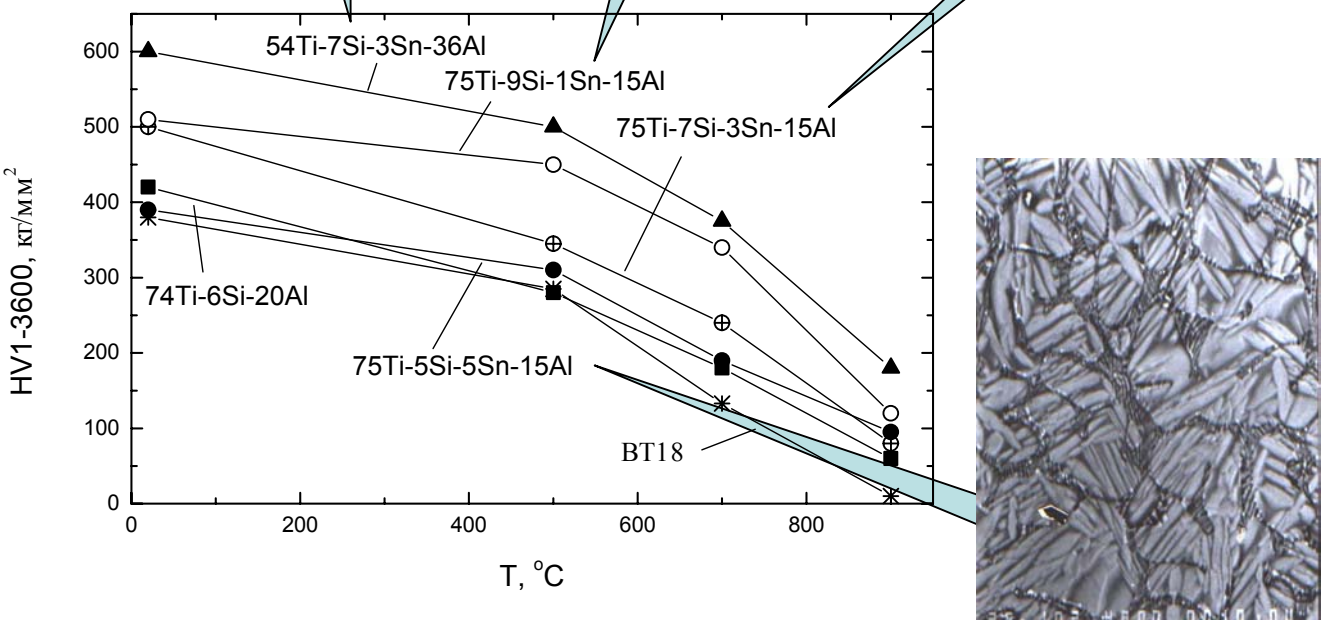




Long-term hot hardness of Ti-Si-Sn-Al alloys

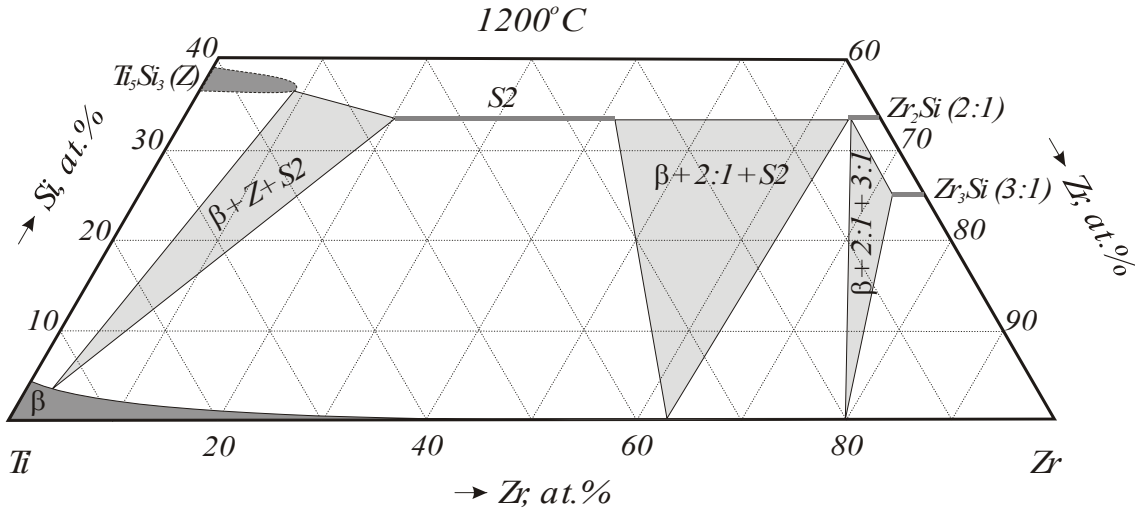
Data obtained by Dr. O.Ban'kovsky



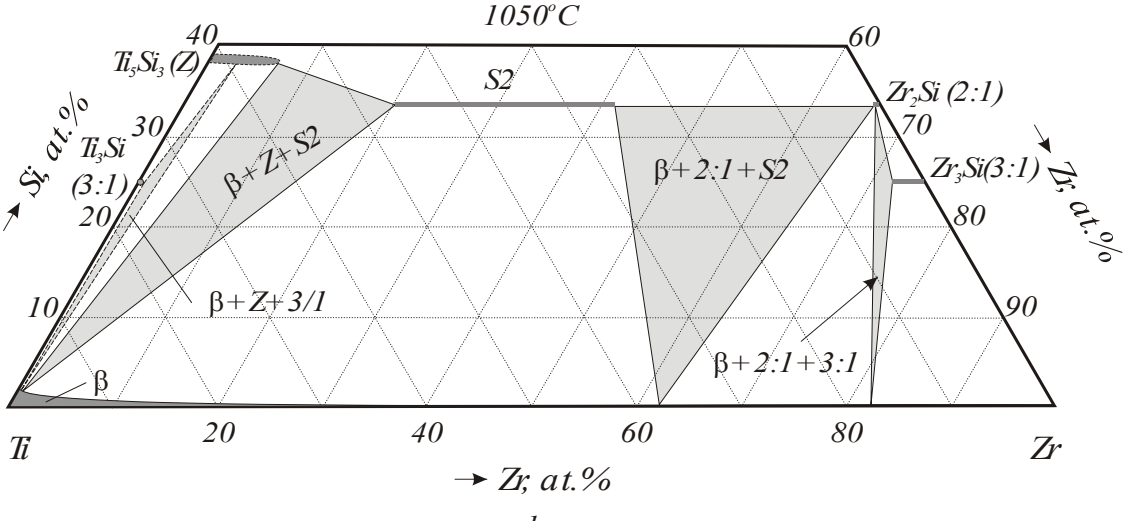


Isothermal sections of the Ti-Zr-Si system

N.H.Salpadoru et. al, 1995



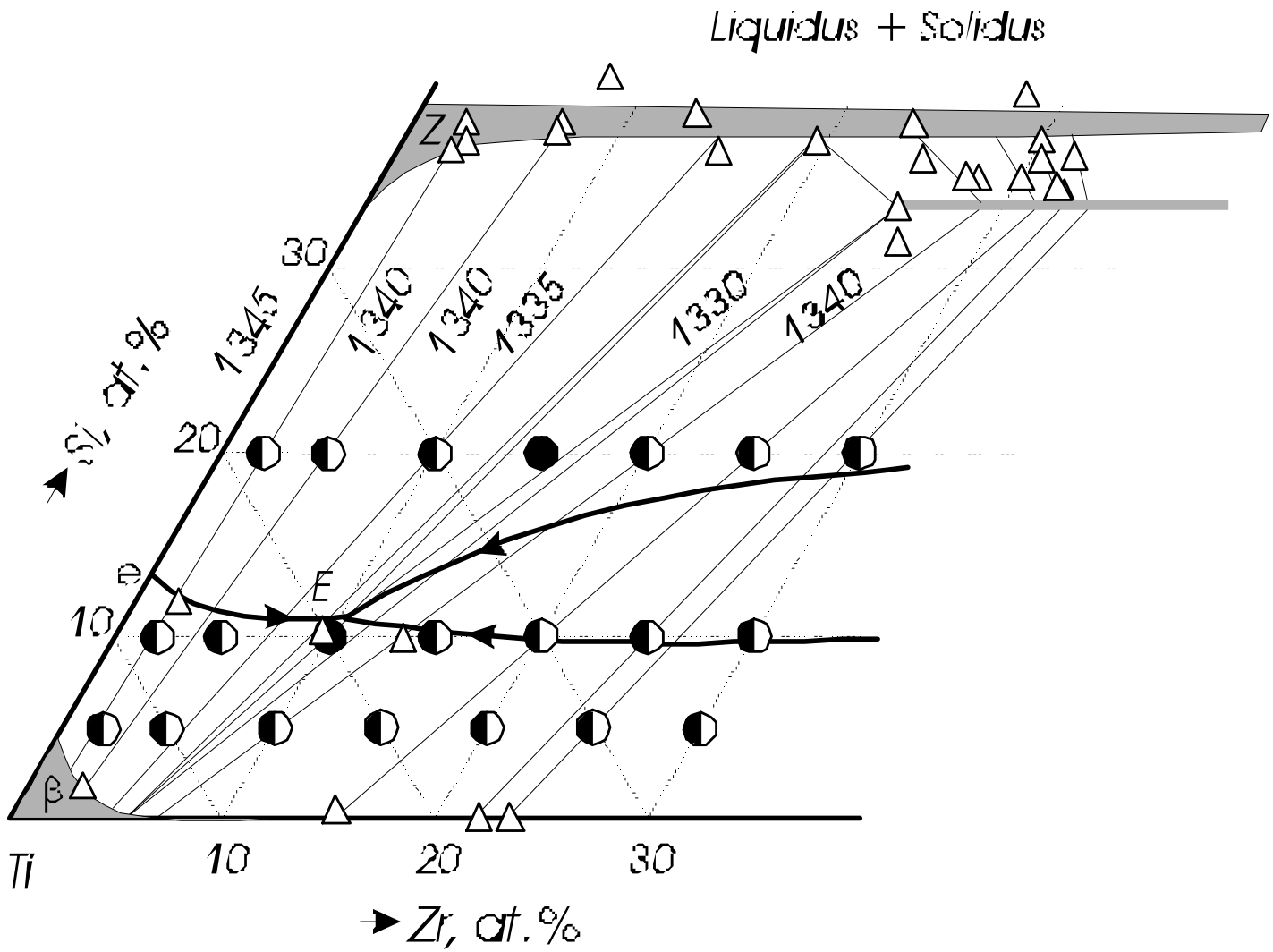
a



b

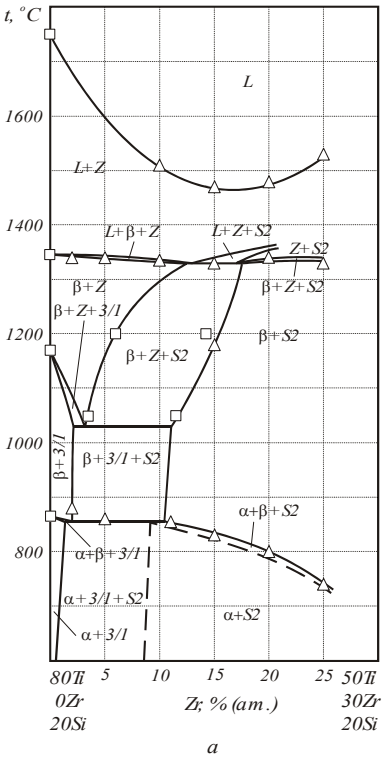
Ti-corner of the Ti-Zr-Si melting diagram

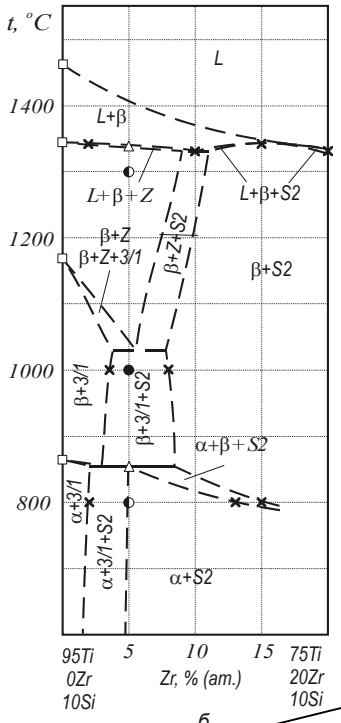
our data



Isopleths and some properties of Ti-Zr-Si alloys

M.Bulanova et. al, to be published

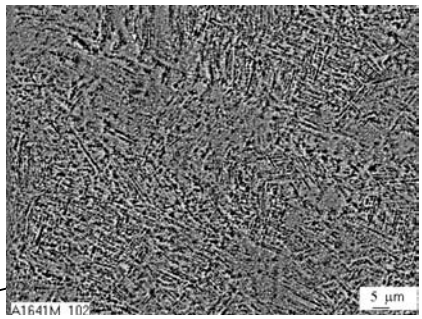


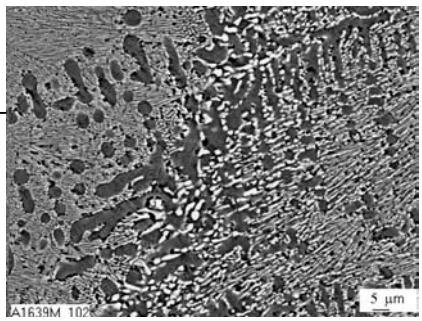


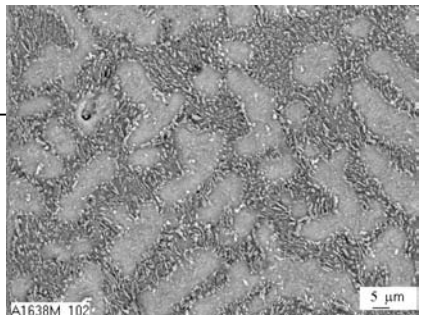
Two factors in competition

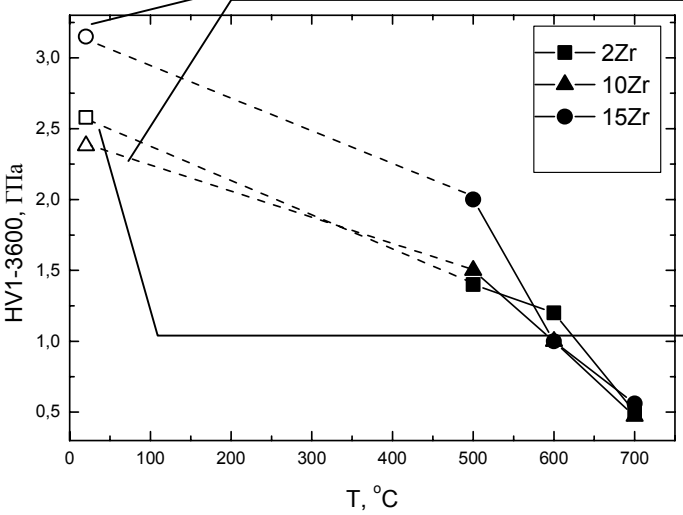
– dispersity of the structure

– the temperature

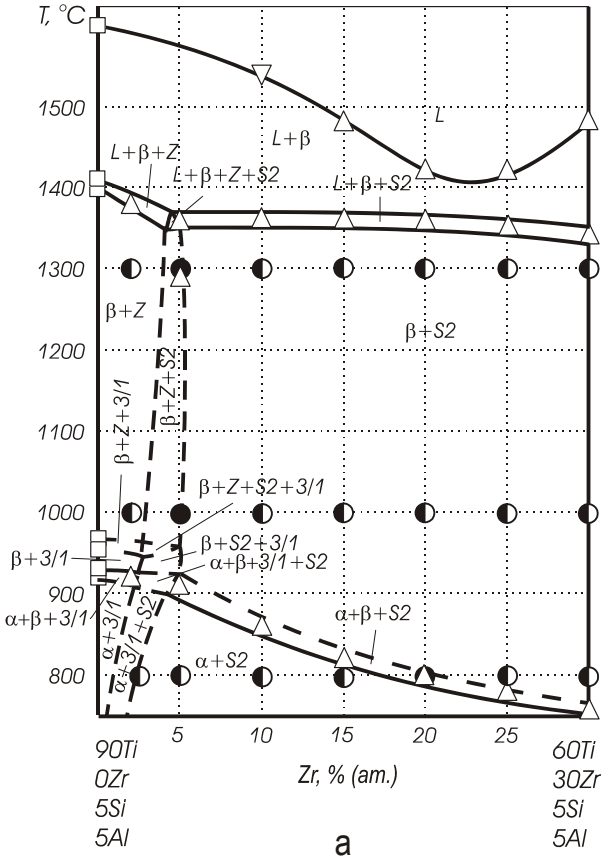


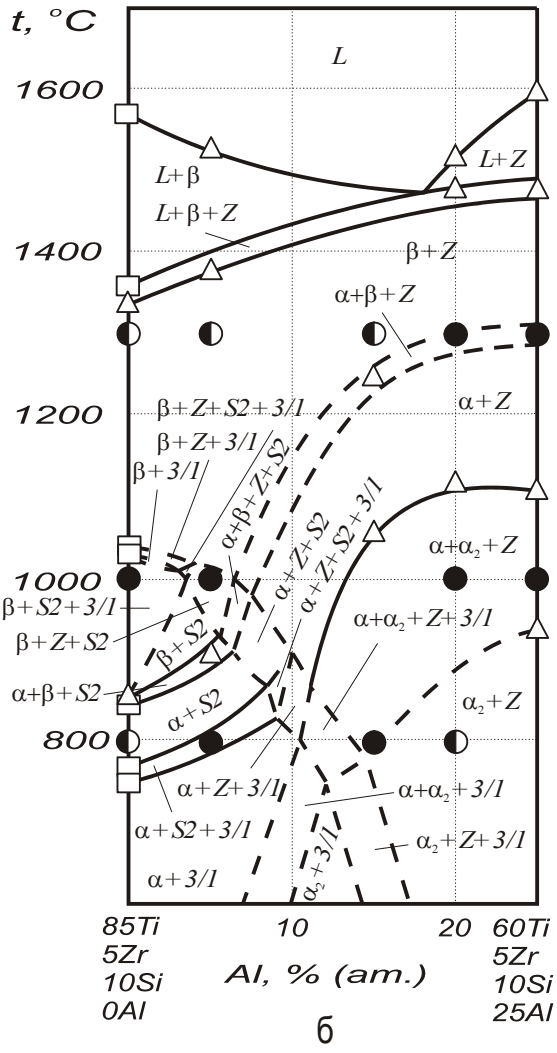


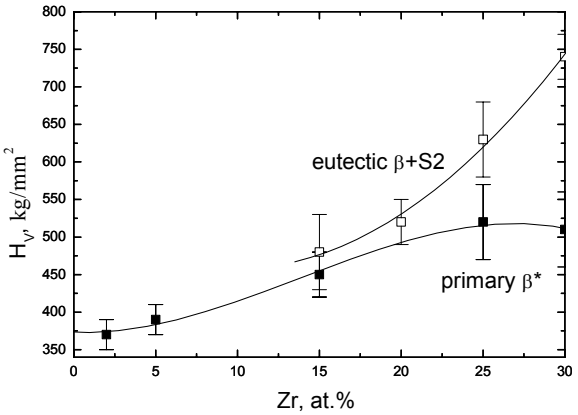


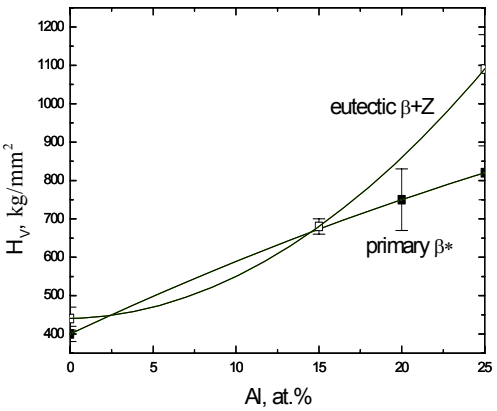


Isopleths and microhardness of the Ti-Zr-Si-Al alloys

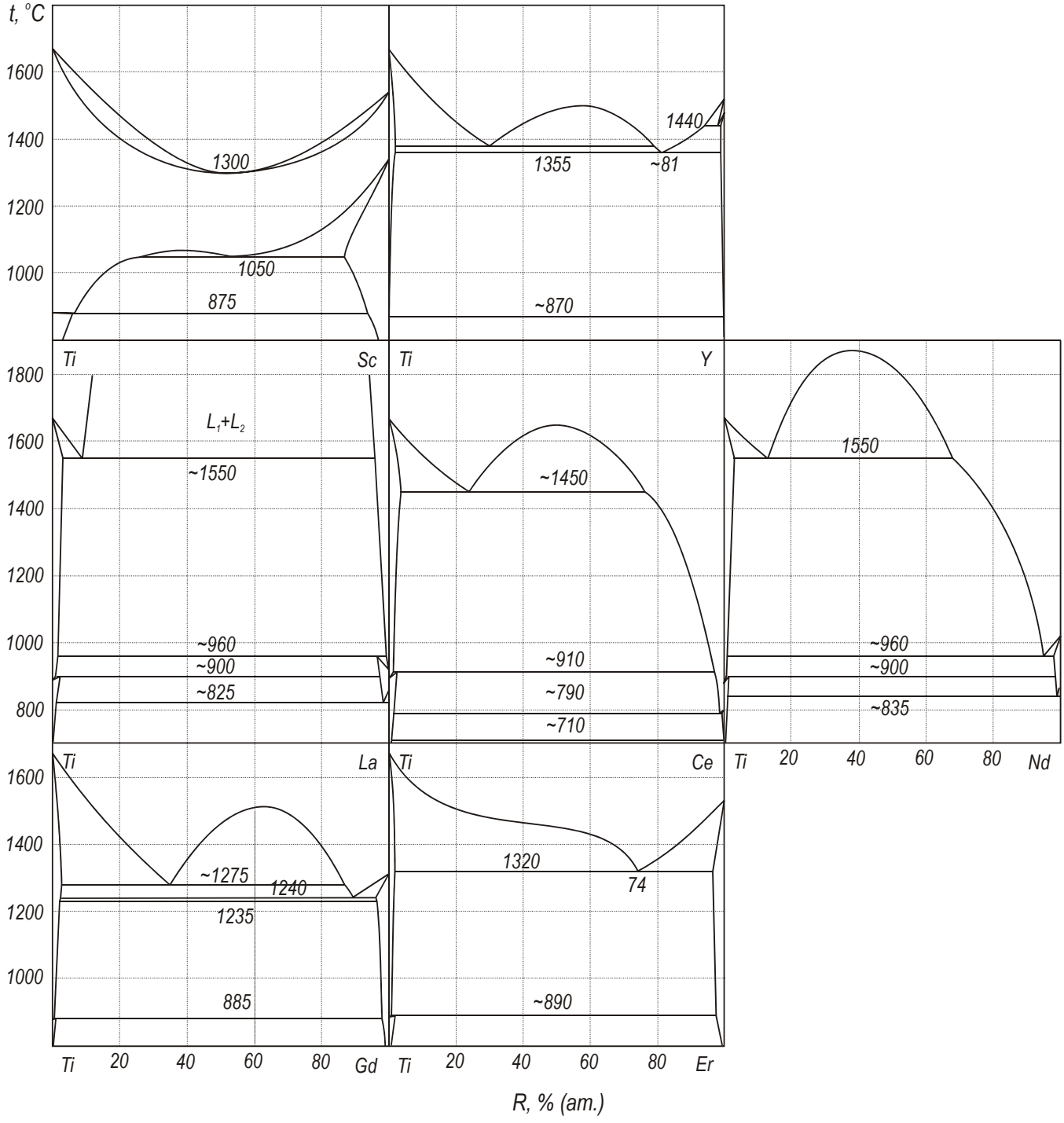






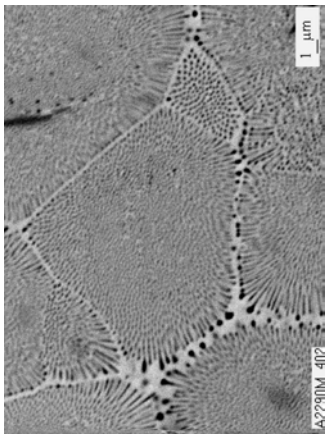


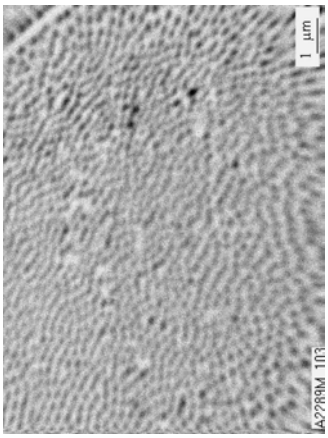
Ti-R phase diagrams from [T.Massalski2]

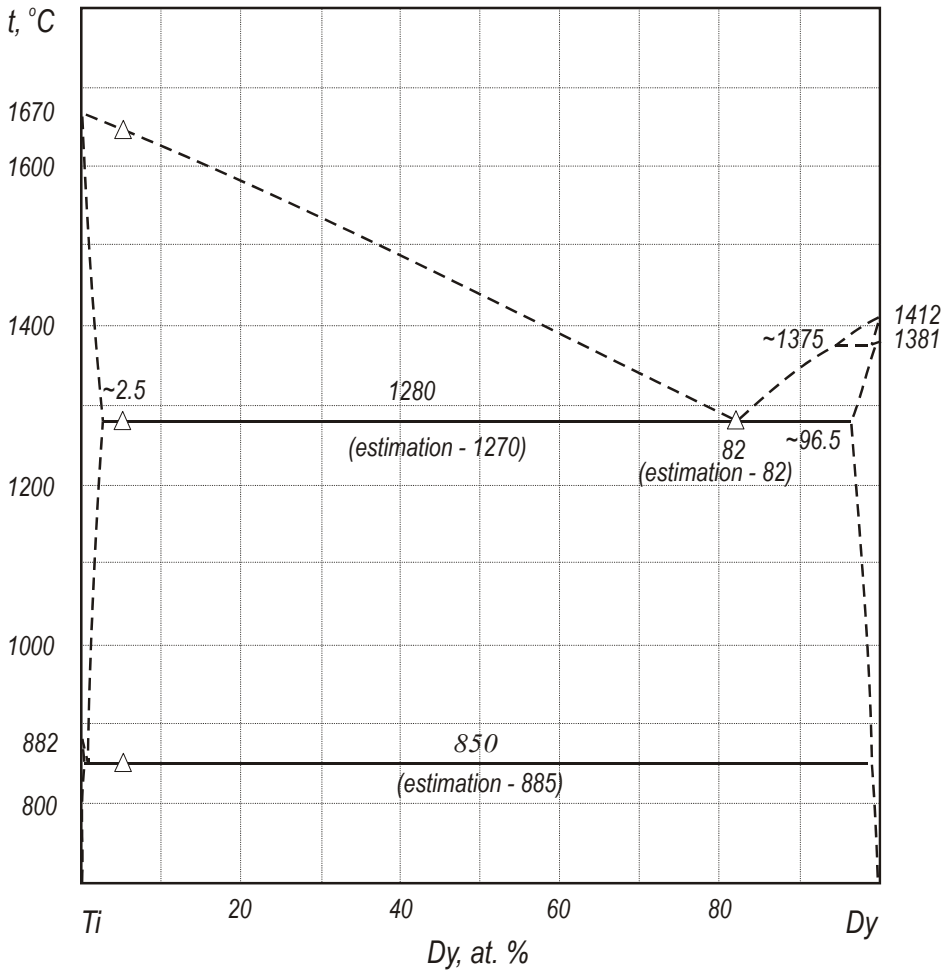


Ti-Dy phase diagram

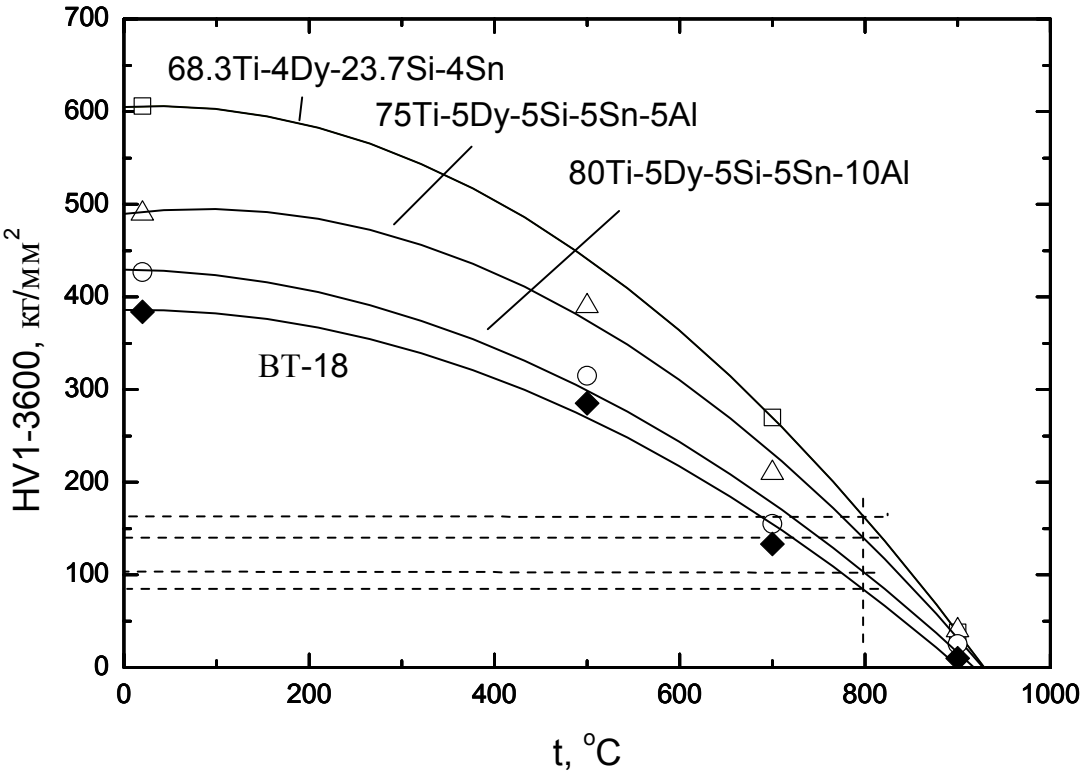
M.Bulanova et. al, 2003, to be published







Long-term hot hardnes of Ti-Dy-Si-Sn-Al alloys



General conclusions

- For the practical usage phase fields with participation of the Ti_3Si-phase can be ignored

- Understanding of the relations of the details of phase diagrams, crystal structure of the phases and metal chemistry of the components on the one hand and mechanical properties of the phases and materials in the whole on the other hand is absolutely necessary for effective process of materials elaboration