

UDK 622.785

Sixty Years of the Theory of B. Ya. Pines

M. M. Ristić^{1*)}, M. V. Nikolić²

¹Serbian Academy of Sciences and Arts, Belgrade, Serbia

²Center for Multidisciplinary Studies of the University of Belgrade, Belgrade, Serbia

Modern science of sintering is objectively based on fundamental work published by Ya. I. Frenkel', B. Ya Pines and G. Kuczynski in the mid forties of the previous century. They analyzed problems of the growth of particle contacts and pore healing during sintering. B. Ya. Pines published his pioneer paper "On (solid state) sintering" [1] in 1946 (fig. 1).



B. Ya. Pines

In this paper the problem of vacancy diffusion in the crystal lattice that reduces pore volume during sintering was analyzed for the first time. G. Kuczynski later used this mechanism in his classical paper investigating problems of self-diffusion as a sintering mechanism of metal particles [2].

B. Ya. Pines stated:

"Let us analyze a body with linear dimensions L , representing a pressed powder with homogenous grains with equal dimensions λ , where $\lambda \ll L$. Atom positions are located in pores of such a body close to grain contacts and their potential energy differs only slightly (for ΔU) from the normal value in a crystal lattice of this material – U_0 . This characterizes a relatively high probability W of atom jumps (when the body is heated) from grains into pore space close to "contacts" with simultaneous formation of holes in the grain."

Further:

"... This way pore "healing" close to contacts occurs..."

It is interesting that six months before B. Ya. Pines published his paper "On (solid state) sintering", Ya. I. Frenkel published his paper "Viscous flow in crystal bodies" [3]. Ideas on pore healing using a mechanism of "viscous" pore healing were presented in this paper. Surface strain forces cause viscous flow of the crystalline body into the pore volume causing pore healing (Fig. 1).

*) Corresponding author: mmristic@mi.sanu.ac.yu

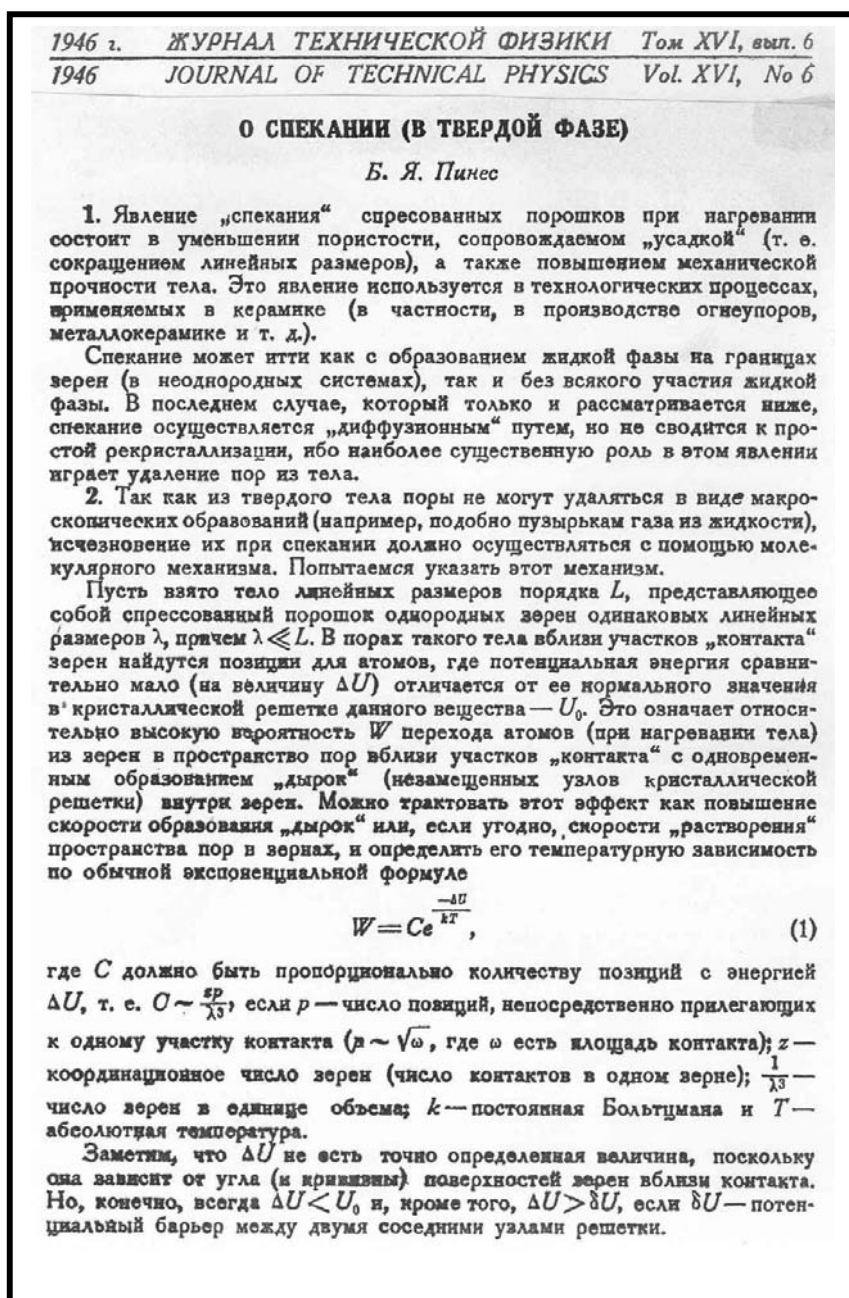


Fig. 1 The first page of B. Ya. Pines's manuscript.

B. Ya. Pines devoted more than twenty years to further development of the physics of sintering. Objectively speaking the results of his research represent a significant contribution to the current level of the science of sintering.

References

1. B. Ya. Pines, J. Techn. Phys., 16, (1946), Vol. 6
2. G.C. Kuczynski, J. Appl. Phys., 20 (1949), 1160
3. Ya. I. Frenkel', J. Phys., USSR, 9 (1945), 385