4.4.7. SENSOR OF NON-DESTRUCTIVE ESTIMATION OF SURFASES STATE IN VACUUM

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Now we use many different sensors types of residual pressure sensors (gauges), nevertheless, till now day there is not sensor type, which may be used for residual pressure measurement in wide range ($10^5 – 10^{-10}$ Pa) and for the surface coverage coefficient measurement simultaneously. The presented sensor is based on the friction coefficient functional dependence of residual pressure also as of coverage coefficient (fig 1, 2) [1, 2]. The idea [3] of new vacuum sensor creation for residual pressure measurement in super-wide range of pressure meaning was born as a result of so called "dry friction" researches [1, 2, 4]. The functional dependence of "so called" dry friction coefficient as a function of "vacuum" exists as for dielectric-dielectric friction pairs [4] also as for metal-metal friction pairs [5, 6]. The experiments show that mentioned functional dependence exists also in case of ball bearing work in vacuum [7]. It was theoretically shown [1, 2, 6], that the main parameter of "dry friction" is a coverage coefficient Θ_Σ, which consists mainly of sorbed water. Dry friction process is a complex process which may be considered consisting of some different components: 1-capillary component acts in low and middle vacuum (at summarized coverage more 2). Viscose component acts in low, middle and in high vacuum (at summarized coverage less 2), 2-ahesive component acts in high and ultra high vacuum (at $2 > \Theta_\Sigma > \Theta_{\Sigma CH}$), 3-cohesive component acts in extremely high vacuum in case of smooth surfaces ($\Theta_\Sigma < \Theta_{\Sigma CH}$). It was shown, that coverage coefficient is correlated with residual pressure according, BET [9] equation and with parameters of friction pair [6]. As it is shown the four maximum meaning of friction coefficient exist:

1. At $\Theta_\Sigma = 20 \ldots 150$ (at $\Theta_\Sigma = \Theta_{max}$) because of the largest meaning of contacting square, which is close to geometry (nominal) contacting area.
2. At $\Theta_\Sigma = 2$ because of maximum value of viscous friction gradient in the "quasi-liquid" part of the summarized coverage.
3. At $\Theta_\Sigma = 1$ because of the largest meaning of the smooth contacting square covered with a sorbed gas.
4. At $\Theta_\Sigma < (N + F_{CHN})/(\sigma_B \cdot A \cdot P^4(X))$ because of the largest (cohesive) attractive energy (energy of friction) in contacting spots.

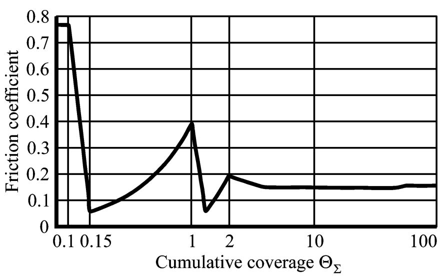

Fig. 1. Variation of theoretical value of friction coefficient for Si – Si friction pair (silicon monocrystal friction pair) versus cumulative coverage

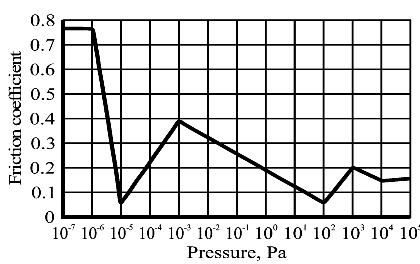

Fig. 2. Variation of theoretical value of friction coefficient for Si – Si friction pair (silicon monocrystal friction pair) versus residual pressure

The results, which were received by different authors at different conditions of the experiments (P, T, RH, see [4, 5, 7, 8] are very close one to another ones, being presented as a functions of coverage coefficient and it support the idea about the unity of “different” friction results shows the possibility to create new vacuum sensor for residual pressure and coverage coefficient measurement.

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