FACTA UNIVERSITATIS
Series: **Mechanical Engineering** Vol. 16, N° 1, 2018, pp. i - ii

FOREWORD TO THE THEMATIC ISSUE *ADHESION AND FRICTION: SIMULATION, EXPERIMENT, APPLICATIONS*

Sergey G. Psakhie

Institute of Strength Physics and Materials Science, Russian Academy of Sciences, Tomsk, Russia

EDITORIAL

This thematic issue contains selected papers related to presentations at the International Workshop "Adhesion and Friction: Simulation, Experiment, Applications", Technische Universität Berlin, November 13-16, 2017 organized by the Technische Universität Berlin and the Institute of Strength Physics and Materials Science of the Russian Academy of Sciences with the financial support of the Deutsche Forschungsgemeinschaft.

The papers of the present issue are devoted to the following topics:

- Numerical simulation of JKR-type of adhesion, in particular of brush-structured flat-ended indenters (Q. Li and V.L. Popov). This topic is interesting both regarding numerical simulations of adhesive contacts with the Boundary Element Method [1] and in the context of much debated influence of the "contact splitting" on the strength of adhesive contacts,
- Adhesive contact of gradient media with finite range adhesive forces (E. Willert). This work is a generalization of the famous Mauger theory [2] with the Dugdale interaction potential in the case of gradient media. The gradient media contact is of upmost importance for many medical and technical applications,
- Adhesion between a rigid indenter and a thin layer on a rigid substrate (A. Papangelo). This problem is also extremely important for numerous applications. It generalizes the known solution for parabolic body to an arbitrary power-law profile using a very simple and elegant method of reduction of any axis-symmetrical adhesive problem to the corresponding non-adhesive one (suggested by V.L. Popov, and independently by M. Ciavarella). For further generalizations of the method see this issue (V.L. Popov, Solution of adhesion problem on the basis of the known solution for non-adhesive one),
- An important focus of this thematic issue is adhesive wear. Recent work by the group of Molinari published in *Nature Communications* [3] provides convincing verification of a criterion for adhesive wear suggested by E. Rabinowicz in 1958 [4]. This criterion can now be considered as a solid basis for better physical understanding of wear. In the paper "Adhesive wear: Generalized Rabinowicz' criteria", V.L. Popov discusses

possible generalizations of the logic used by Rabinowicz to layered or damaged systems,

- The paper by Dimaki et al. about the "Simulation of fracture using a mesh-dependent fracture criterion in the discrete element method" develops the ideas of the simulation of adhesive contacts using a mesh-dependent detachment criterion [1] applied to the problem of fracture and wear. It goes from the analogy between adhesive contacts and cracks and considers transfer of the ideas developed in [1] and cited therein to fracture mechanics,
- The paper by V. Pakhaliuk and A. Poliakov is devoted to consideration of wear of a hip joint under realistic daily activities such as walking, jumping and a series of "disturbances" which is of utmost importance both for a realistic estimation of the lifetime of the joint and for an optimized design,
- An interesting general discussion of problems in the theory of adhesive wear is provided by M. Ciavarella and A. Papangelo. They use a humorous name of "contact sport" for the youngest activities in the field of contact mechanics of rough surfaces used by R. Carpick in his Science paper [5] and analyze critically the state of the art, the usefulness of the present theories and some conclusions which could be drawn specifically for the problem of adhesive wear,
- The paper by R. Balokhonov et al. considers the process of stir welding which is a combination of friction, adhesion and plasticity problem, and,
- The issue is completed with two short communications. A note by M. Ciavarella is devoted to an attempt of a simple interpretation of recent observations published in the PNAS [6] on the interrelation of the contact area in an adhesive contact and tangential load. A short note by V.L. Popov documents the reduction of the adhesive contact problem to a non-adhesive one and generalizes it to non-axisymmetric situations using the notion of the "filling factor" suggested in [1].

The organizers are thankful to the Deutsche Forschungsgemeinschaft for financial support of the Workshop and to J. Wallendorf and J. Starcevic for organizational assistance.

REFERENCES

1. Popov, V.L., Pohrt, R., Li, Q., 2017, *Strength of adhesive contacts: Influence of contact geometry and material gradients*, Friction, 5(3), pp. 308–325.
2. Maugis, D., 1992, *Adhesion of spheres: The JKR-DMT-transition using a Dugdale model*, Journal of Colloid and Interface Science, 150, pp. 243-269.
3. Aghababaei, R., Warner, D.H., Molinari, J.-F., 2016, *Critical length scale controls adhesive wear mechanisms*, Nature Communications, 7, 11816.
4. Rabinowicz, E., 1958, *The effect of size on the looseness of wear fragments*, Wear, 2, pp. 4–8.
5. Carpick, R.W., 2018, *The contact sport of rough surfaces*, Science, 359(6371), pp. 38-38.
6. Sahli, R., Pallares, G., Ducottet, C., Ben Ali, I.E., Al Akhrass, S., Guibert, M., Scheibert, J., 2018, *Evolution of real contact area under shear*, Proceedings of the National Academy of Sciences, 115(3), pp. 471-476.