Editorial corner – a personal view

Once more on the proper use of terms and definitions: this time about the term ‘self-healing’

S. Fakirov*

Centre for Advanced Composite Materials, Department of Mechanical Engineering, The University of Auckland,
Building 903 Room 240, 314 Khyber Pass Road, Newmarket Campus, Private Bag 92019, 1142 Auckland, New Zealand

Some time ago, in the same journal (<https://doi.org/10.3144/expresspolymlett.2015.62>) as well as elsewhere (<http://dx.doi.org/10.1016/j.mattod.2015.10.001>) the proper use of the terms ‘phase’ and ‘component’ is emphasized, which, particularly in the composites community, are wrongly used interchangeably although both have clear and strict definitions in thermodynamics. By the way, the term ‘component’ as a chemically independent constituent of a system will help us to derive the proper definition of the term ‘self-healing’.

Let us remember that according to The Cambridge Dictionary, ‘self-healing’ is used ‘to describe a piece of equipment or system that has the ability to discover and correct faults without needing outside help’, that is, the process of self-healing involves *one-component* only!

Genuine ‘self-healing’ was described for first time some 40 years ago (<https://doi.org/10.1002/pol.1984.180221208>) named ‘*chemical healing*’ in order to distinguish it from the ‘*physical healing*’, being a results of diffusion processes only, that is without performing of chemical reactions – widely studied before. The chemical healing can be observed in condensation polymers only and is related to additional polycondensation and exchange- (trans) reactions being typical for this class of polymers (<https://doi.org/10.1016/j.progpolymsci.2018.09.003>). Inherent peculiarity of chemical healing is the fact that it takes place between molecules of the damaged material only, *i.e.* the process involves one component only.

Both types of healing, the physical and the chemical healing, take place in one-component systems only and represent real cases of ‘*self-healing*’. During the last decade, the interest in the healing phenomenon was revitalized involving chemical reactions with specially added substances. Currently there are at least 15 types of such reactions, (<https://doi.org/10.1016/j.progpolymsci.2015.04.004>), which offer self-repairing through the cleavage and reformation of specific bonds. These cases of material repairing hardly could be called ‘self-healing’ because the reactions are between the damaged material and other chemically different substances, *i.e.* the healing process involves *two components*. Possibly, for such cases the term ‘*chemically assisted healing*’ would be more appropriate. Again, in the case of chemical healing the chemical reactions involve the molecules of the material needed a healing only!

Even more complex is the case of repeated self-healing of wider cracks discussed recently (<https://doi.org/10.3144/expresspolymlett.2020.73>). It is suggested to close the wider cracks first with shape memory material, which allows the subsequent self-healing reaction across the interface. Obviously, this is a case of ‘*mixed functionality and chemically assisted healing*’ being quite different from the case of ‘*self-healing*’ as defined above.

Concluding, the self-healing process involves one component only, even in multi-component systems. The repairing of damaged materials as result of chemical reactions between two or more components is ‘*chemically assisted healing*’ but not ‘*self-healing*’!

*Corresponding author, e-mail: s.fakirov@auckland.ac.nz
© BME-PT