29th International conference on atomic collisions in solids &
11th International symposium on swift heavy ions in matter

ICACS & SHIM 2022

Book of Abstracts

June 19–24, 2022
University of Helsinki, Finland

Welcome to ICACS & SHIM 2022

It is with great pleasure, and without hesitation, that we welcome you, on site and virtual, to the jointly arranged 29th International conference on atomic collisions in solids (ICACS) and the 11th International symposium on swift heavy ions in matter (SHIM). While both conferences have been long running, and especially the ICACS conference has already been arranged during extraordinary turns in world history, never before have world events necessitated postponing the conference twice, first from 2020 to 2021, then again from 2021 to 2022. The reason for this is, as all of those reading this text now, in 2022, well know, the COVID-19 pandemic, that brought travel and physical meetings to a halt all across the globe.

We are very pleased that we can now, in June 2022, finally arrange the conference without any local limitations due to the pandemic situation. Yet on a global level many countries still have rules in place that make travel difficult. To enable participation from all countries, we chose to arrange the conference for the first time in a hybrid format, supporting both on site and virtual participation. This solution, necessitated by the present circumstances, can also be considered an experiment that will guide the organization format of future meetings.

We firmly believe that face-to-face scientific discussions during the conferences will inspire many new collaborations, build new bonds, inspire new daring unprecedented ideas. This is particularly important in times that are difficult from both a global health and political viewpoint.

We welcome you all to a week of high-level science and good-spirited community building during the white summer nights of Finland.

Helsinki, June 10, 2022

Flyura Djurabekova	Kai Nordlund
Professor	Professor
Chairperson	Co-chairperson

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Comprehensive model of SHI impacts: from ion passage to track formation

R.A. Rymzhanov[1,2,*], **J.H. O'Connell**[3], **N. Medvedev**[4,5], **M. Ćosić**[6], **V.A. Skuratov**[1,7,8], **A. Janse van Vuuren**[3], **S.A. Gorbunov**[9], **A.E. Volkov**[1,9]

[1]*Joint Institute for Nuclear Research, Dubna, Russia;*
[2]*The Institute of Nuclear Physics, Almaty, Kazakhstan;*
[3]*Nelson Mandela University, Port Elizabeth, South Africa;*
[4]*Institute of Physics, Czech Academy of Sciences, Prague, Czech Republic;*
[5]*Institute of Plasma Physics, Czech Academy of Sciences, Prague, Czech Republic;*
[6]*Vinča Institute of Nuclear Science, Belgrade, Serbia;*
[7]*National Research Nuclear University MEPhI, Moscow, Russia;*
[8]*Dubna State University, Dubna, Moscow Region, Russia;*
[9]*P.N. Lebedev Physical Institute of the Russian Academy of Sciences, Moscow, Russia;*
[*]*rymzhanov@jinr.ru*

A combined Monte Carlo (MC) and Molecular Dynamics (MD) approach enables us to study in detail effects of different stages of swift heavy ion (SHI) track formation. The MC model (TREKIS [1]) describes excitation of the electronic system and energy transfer to the lattice providing initial conditions for the MD simulations of subsequent lattice response. We discuss here the kinetics of individual track formation, tracks overlap and surface modifications in some amorphizable (YAG, Mg_2SiO_4) and non-amorphizable (Al_2O_3, MgO, CaF_2) solids irradiated with SHIs. High-resolution transmission electron microscopy analysis of samples irradiated with Xe and Bi ions is used to validate the developed model and to investigate the link between the basic properties of the studied materials and the kinetics of structural changes of the targets. We demonstrate the following:

1) The size and morphology of individual latent tracks and tracks overlap at high fluences are strongly affected by recrystallization of the transiently disordered zone [2].

2) Different spectra of electrons generated by ions of different energies result in a velocity effect of track formation and a mismatch between the position of the maximal damage and the Bragg peak of the projectile energy loss [3].

3) Protrusion of molten material and a final structure of surface defects induced by an SHI are governed by mobility of target atoms, surface tensions and recrystallization of a material during the ultra-short cooling period [4].

4) A target thickness affects formation of surface defects under SHI irradiation: the thinnest layers form a through hole, semispherical and spherical hillocks are created after an ion impact at medium thicknesses, whereas nanoparticle emission occurs from thick layers [5].

5) Impact of an SHI under a grazing incidence results in formation of a groove-like structure vs. a chain of nanohillocks depending on material and irradiation properties. It can be concluded that hydrodynamic (Rayleigh) instability of molten material on the surface dominates in hillock chain formation over the effect of the dependence of ion energy loss on the impact parameter.

References

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