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Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Aleksandra Boldyreva

PhD Program: Materials Science and Engineering

Title of Thesis: Unraveling bulk and interfacial degradation mechanisms in perovskite solar cells

Supervisor: Prof. Pavel Troshin

Name of the Reviewer: Prof. Francesca Brunetti

I confirm the absence of any conflict of interest	**Signature:**  **Date: 07-06-2020**

Reviewer's Report

The thesis by Mrs. Boldyreva is a very high quality work in which she investigated the degradation mechanism of perovskite solar cells under several aging condition. In particular, she first focused on exploring the interfacial degradation pathways induced at the interfaces between the methylammonium lead iodide (MAPbI3) and the commonly used charge transport layer (CTL) materials. Then she did a systematic study of a series of four commonly used hole-transport layer materials (HTLs) in combination with five different lead halide perovskite absorbers demonstrating that the interfacial degradation effects depend not only on the composition and properties of the HTL materials but are also largely affected by the perovskite formulation. As final experiment, she evaluated the possible use of such technology for space applications considering the stability of such cells when irradiated with gamma rays.

The manuscript of this PhD is very well written, there are a lot of interesting details necessary to understand the work performed by Mrs. Boldryeva. The work is relevant and interesting, the methodology has been appropriate, and the state of the art has been thoroughly reviewed. The work is very significant and relevant respect to the state of the art as has been dedicated to the understanding of the degradation mechanism of PSC, which is one of the central topic under study.

As for the research, I think it is very solid and interesting. The description of the experiments performed and the experimental results are well detailed and explained. The references reported at the end of the manuscript are up to date.

I have appreciated the way the research has been carried out starting from structural analysis to device performances.

I think that the manuscript would benefit from a spell check (infinitives where past participles are supposed to be found, “s” missing from plurals and from 3rd person present tenses, etc.) and some minor changes that are required.

In particular:

Pg. 26 in the phrase: “However, the absence of MA+ cation significantly worsens phase stability and requires more careful film preparation” What does the candidate mean with more careful film preparation? Maybe it could be good to add a phrase to specify.

p.35: “Aging experiment All prepared samples were placed in a specially designed aging chamber integrated into MBraun glove box. White light with 50 mW/cm2 intensity was provided by metal-halide lamps, which usually provide a decent match with the solar AM1.5G spectrum. The sample temperature during the experiments was 45±3 oC.” Could it be possible to specify the mismatch of the source used with the AM1.5?

The work led to a relevant number of publications in high impact factor journals.

In conclusion, the work is very valuable and is ready for public defense.

Provisional Recommendation

☒ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*

☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate’s thesis according to the recommendations of the present report*

☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*