Contribution ID: **37** Type: **Abstract TEC2ZERO**

Perovskite Solar Cells for Satellites - Lightweight, Low-Cost and Resource-Friendly

Satellites are essential for modern society, supporting functions like weather forecasting, climate protection, communication, IoT, and autonomous driving. Small satellites, in particular, are becoming increasingly important due to their cost-effectiveness and ability to be mass-produced. They often rely on onboard power systems since they must operate autonomously, and the cost of launching satellites, ranging from 10,000 to 50,000 dollar per kilogram, makes every gram crucial. Traditional solar modules for space applications, though efficient, are bulky and heavy, and offer a power-to-weight ratio of less than 0.2 W/g, making power management a critical factor in satellite design.

In contrast, metal-halide perovskite solar cells offer a transformative advantage with ultrathin layers and exceptional power-to-weight ratios of up to 20 W/g, while being composed of abundant elements. Thereby they can reduce payload mass by up to 99 % compared to traditionally used solar cells, which could not only reduce launch costs but enable unprecedented mission flexibility by dramatically relaxing the power budget.

At the Chair of Electronic Devices, we are pursuing two major initiatives to leverage these advantages: the NATO funded “SpacePerCells” project, in collaboration with international academic partners in Uzbekistan, and the “PeroSat” project, supported by the European Fund for Regional Development together with local industry in NRW. In order to harness the unique properties of perovskite for space, we have to ensure operational stability. As perovskites have already proven their high resilience against ionizing radiation, we focus on two other key stressing factors in space: vacuum and atomic oxygen. To this end, we develop a novel thin-film barrier technology to create ultra-thin permeation barriers that will prevent material out-diffusion in vacuum or in-diffusion of harmful oxygen radicals, without compromising weight or electrical performance. Our initial results are promising, showing that even unoptimized thin-film barriers can extend the tolerable vacuum exposure significantly.

Primary authors: BOCCARELLA, Gianluca (Lehrstuhl für elektronische Bauelemente); OPITZ, Sven (Lehrstuhl für elektronische Bauelemente)

Track Classification: Future Technologies: Energy Efficiency