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Less Toxic Organic Photovoltaic Materials

Written by Sandra Henderson

As part of the European Project Sunflower, nanotechnology researchers at Universitat Jaume I (UJI) in Castelló, Spain, have helped to develop less toxic organic photovoltaic (OPV) materials viable for industrial production.

“The Sunflower project has focused on providing a complete solution for the organic photovoltaic technology to increase power conversion efficiency and stability, and to reduce production costs,” says the director of UJI’s Institute for Advanced Materials Research (INAM), Professor Juan Bisquert, who collaborated with researcher Dr Antonio Guerrero on the project.

Over the course of four years, 17 international research institutions and businesses have worked together on multiple studies. Bisquert says the development of less toxic ink formulations compatible with industrial requirements has been one of the highlights of the project.

Key findings of Project Sunflower

Focusing on improving chemical reactivity and structural compatibility and through advanced electrical measurements, the team of nanotechnology researchers was able to demonstrate that ink formulations based on non-halogenated solvents can be printed using industrially relevant techniques to provide device efficiencies comparable to those obtained with halogenated solvents. “Due to the nature of the printing techniques, device areas are larger than previously demonstrated on the laboratory scale,” Bisquert says, adding that developing understanding of the operational principles of OPV has been key to improving device

efficiencies. Furthermore, he says: “Cradle-to-crate studies have shown that the environmental impact of OPV is lower than other thin-film technologies.”

Applying the doctor blade technique

The professor explains that highest power conversion efficiencies in OPV are typically obtained using the spin coating deposition process, which is incompatible with industrial requirements. The Sunflower project, on the other hand, has applied the doctor blade technique as a semi-industrial process. “Partners have been able to close the gap with spin coating whilst increasing the printable device area,” Bisquert reports.

Novel, less toxic materials

“The Sunflower project has developed a range of new materials for each of the layers that constitute the complete OPV device,” Bisquert says. “These include photovoltaic active materials, selective layers to [transport] electrons or positive charges and encapsulation/barrier materials to enlarge the operation lifetime of the devices.”

Impact on next generation of OPV

“The findings of the project bridge the gap between laboratory conditions and industrial requirements, which can make the technology appealing for many applications,” confirms the expert. “OPV technology is very attractive as devices can benefit from new features that are not accessible by other photovoltaic technologies,” he says. “For example, they can be fabricated in flexible or semitransparent configuration to be incorporated in textiles, building-integrated devices or consumer electronics. Due to the endless variety of colors that can be selected, devices can be aesthetically appealing and can play a role in designs for new concepts of electronics devices.”

Outlook

Bisquert concludes by saying that further work is still needed to improve device efficiencies before opening up new markets that are currently dominated by other photovoltaic technologies.

Written by Sandra Henderson, research editor *Solar Novus Today*