IEC TC119 – International Standards for Printed Electronics

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Abstract

IEC TC119 (Printed Electronics) represents a significant opportunity for our community. International Standards are an enabling activity to bring a technology to industrialisation and will thus aim to address the "Lab to Fab" bottleneck.

The activities of IEC TC119 are now reaching a critical point. It is important that it has engagement with and contributions from the community represented at this conference.

This paper gives a brief overview of the International Standards process and the organisation of IEC TC119. It looks at the proposed structure for the standardisation of Printed Electronics and surveys the areas currently being worked on.

A key theme through this work is how this community can contribute to these important standards and how individuals and companies can benefit from participation.

Introduction

While printing is an "enabling" technology to produce functionality, International Standards is an "enabling" activity for Industrialisation. The new IEC Technical Committee 119 exists solely to produce International Standards for Printed Electronics.[1] The purpose of this paper is to outline some of the technical challenges faced by IEC TC119. We can then move on to identify areas where IEC TC119 and the Digital Fabrication community can collaborate to mutual benefit and hence promote the industrialisation of this technology.

The overall aim of the IEC TC119 initiative is congruent with that of the Digital Fabrication community. It is to promote and accelerate the industrialization of Printed Electronics. As such it aims to address the "Lab to Fab" issue through the development of a harmonized set of test methods, specifications and technical reports. As a part of this process it also creates a further place for the Printed Electronics community to meet and exchange ideas.

However it is important that IEC TC119 does not do this in isolation. In order to produce meaningful and relevant standards it needs the scientific and technical input that the Digital Fabrication community is most able to provide. This input is likely to come in the following forms.

1. From the industrial community IEC TC119 seeks guidance on the topic areas that are likely to prove of relevance in the 2-5 year time frame. The Technical Experts nominated by the participant nations can then start the process of preparing the relevant standards.
2. From the technical community IEC TC119 requires guidance on the content of the resultant documents. It will not help the "lab to fab" cause if IEC TC119 produces output that is technically flawed.
3. From the academic community and those conducting research with a longer horizon we are looking for guidance on areas where we should be preparing for standardization.

The contribution of the Digital Fabrication community is particularly important in these respects.

The IEC and International Standards

The IEC provides a platform for companies, industries and governments to meet, discuss and develop the International Standards they require. The stated aim of these International Standards is to facilitate global trade and technology transfer. They provide industry and users with a framework for economies of design and production, improved quality of products, and better interoperability. The Digital Fabrication community has a part to play in the work of IEC TC119 through participation in this standardization work. It can help to ensure that the Printed Electronics Standards reflect the best experience of industry, researchers, consumers and regulators.[2]

User needs from International Standards

Different user groups can take away a variety of advantages from the final Standards documentation.

- For the Digital Fabrication industry the appearance of International Standards gives the industry credibility in the wider world as a sign that it is finally going beyond the "hype curve" and emerging into reality.
- For users the availability of standardised test methods and specifications allows for fair comparison of suppliers and products.
- For the Product Development community mature test methods can accelerate progress towards more advanced products.

International Standards communities also provide a meeting place for the community in a similar manner to the NIP/DF conferences.

Printed Electronics standards

The IEC is not the only organization involved in the generation of standards to promote Printed Electronics. One other organization that has made a substantial contribution is the IPC.[3] However, truly International organizations such as the IEC and ISO with their National voting structures bring enhanced credibility to an emerging industry. This is the importance of IEC TC119 (Printed Electronics).

IEC TC119 has only been in existence for around 2 years. It is building a panel of technical expertise in a variety of areas and welcomes participation from the Digital Fabrication community. Certain Working Group areas are beginning to coalesce to promote standardization activities for specific regions of interest in the materials and applications space. Now is the time where your technical contribution would be most valuable as we try to bring Printed Electronics towards industrialization.

IEC TC119 is now developing the hierarchical structure that is common in standards development. A Technical Committee will tend to organise itself into Working Groups. These Working Groups take on the task of developing standards in specific areas. Although the Working Group structure of IEC TC119 has yet to be formally established it is likely that it will look something like that

illustrated in Figure 1. Countries in (parentheses) illustrate the National Bodies that are likely to supply the leadership roles for the Working Groups. So far there are 6 areas proposed for Standardisation activity, plus a Roadmapping exercise that could produce a Report for guidance.

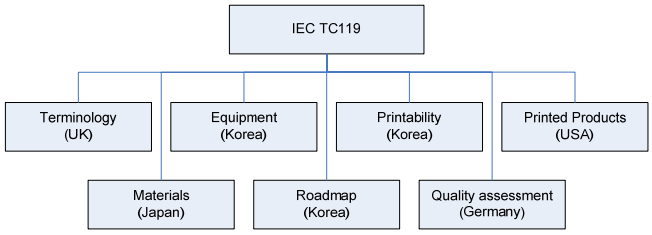

Figure 1 Possible Working Group structure for IEC TC119

The International Standards are written within the Working Groups. Some areas may attract individual standards but due to the complexity of some of the systems it is probable that the work will adopt a further hierarchy. This is the sort of model followed by the IPC for their Printed Electronics Design Guidelines.[4] Figure 2 is reproduced from this document.

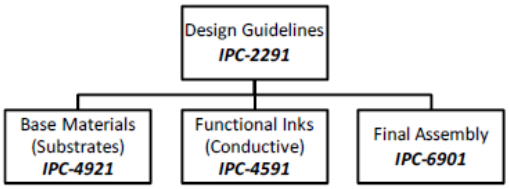

Figure 2 Hierarchy for IPC Printed Electronics Documents

Standards on Terminology

Terminology is a key area for early work. We have to define the terms we use in the Printed Electronics field as in certain cases our use of words is significantly different to those defined in other application areas in electronics. For example, the term "printed circuit" means different things depending on if your background is IEC TC119 or IEC TC91 (Electronics assembly technology).[5] Those with knowledge / background in the area of terminology would be most welcome to contribute, particularly if your background spans application areas that overlap with IEC TC119.

Standards on Materials

It is the area of materials and substrates for printed electronics that the overlap with the Digital Fabrication community is potentially the greatest. At the moment this work looks towards the generation of standard evaluation methods for substrates and inks.

In terms of substrates, proposals so far are confined to evaluation methods for plastic and glass materials. The aim is to cover a broad spectrum of physical, electrical and optical properties of such materials. It is interesting to note that there is no proposal so far for evaluation methods for any fibrous substrates such as paper.

For printable materials the proposals so far cover printable inks for a broad spectrum of properties. Inks that provide conductive, insulator, semiconductor, photovoltaic and light emitting features are being considered by IEC TC119.

There are some existing standards produced by various interest groups. As an example the IEEE has produced a test method to characterize "organic transistors and materials".[6] The document gives guidelines for device characterisation and reporting requirements. Dielectric characterisation issues are given significant coverage.

The technical expertise from the Digital Fabrication community around the Physics and Chemistry of the materials for printing will be essential in this work. Both substrates and inks are complex areas for evaluation methods with multiple criteria. As a result a broad range of expertise is necessary to progress these.

Standards on Printability

The aim of this group of standards is to produce methods to test the way in which materials perform in a printing process. Tests for parameters such as printed line width would belong here. It is anticipated that a number of digital and "traditional" print technologies will be applicable to Printed Electronics manufacture.[7] As a result a wide spectrum of printing expertise will be needed in order to set realistic standards in this area.

This work will likely widen to encompass pre- and post-processing for Printed Electronics and topics in Digital Fabrication instrumentation may become important. Digital workflows are already a topic that has been discussed in IEC TC119 that has appeared in past Digital Fabrication conferences.[8]

It is also important that IEC TC119 attract a wide spectrum of experience to this work. One reason for this is that it would be easy for us to inadvertently reproduce previously existing work. An example of this would be the existing silicon based semiconductor industry, which has already developed methods environmental testing that could be equally applicable to some Printed Electronics applications.[9] It will also be important to reach out to ISO TC130 – Graphic Technology as some of their standards will be applicable here too. An example of this will be their work on offset plate dimensions.[10]

As inkjet technology moves into the Printed Electronics space look out for the possibility that the field of standardization will move into this area too. For example, measurement methods for inkjet drops may be an area of interest.[11]

The IEC TC119 Strategic Business Plan

Every IEC (and ISO) Technical Committee is required to write and maintain a Strategic Business Plan to direct the work of the Technical Committee. The knowledge and experience of the Digital Fabrication community would be a substantial asset to this task, a particularly important function in a topic as fast moving as Printed Electronics.

One element of this task is the topic of Roadmapping. It is not the production of a roadmap for the progress of industrialisation of Printed Electronics as produced by consortia such as the OE-A.[12] In this case the roadmap is for the work of International Standards production process in this area, an attempt to forecast technical areas that are likely to be important in a 2-5 year time frame.

Part of the reason for this planning process is the Timescale of the IEC standards process. It can take a number of years to

produce and issue an International Standard and for good reasons. A consensus has to be reached first within the participants of the Working Group producing the standard. Then the document has to go to vote through various stages by the National Committees who can in turn send back comments for resolution. A well informed Technical Committee is essential to keep this process on track.

Liaison activity

International Standards Technical Committees cannot work effectively in isolation. There is always going to be overlap with other Technical Committees. These are recognized in the IEC structure through formal liaisons with these other groups.

IEC TC119 is in the process of building a network of liaisons in key areas of interest. People with expertise in these areas could make a valuable contribution to the progress of IEC TC119.

- Materials. IEC TC113 (Nanotechnology standardization for electrical and electronic products and systems) like IEC TC119 is relatively new.[13] This committee is setting standards for nanoparticle materials that could find use in printed devices, such as quantum dots and graphene.
- Equipment. ISO TC130 (Graphic Technology) covers many of the standards that pertain to printing machinery, such as offset plate dimensions.[10]
- Devices. IEC TC91 (Electronics assembly technology) is a mature standards committee that has already progressed standardisation for silicon based electronics.[5] As a result their knowledge and structures are valuable to IEC TC119.

Conclusions

In summary, IEC TC119 welcomes the guidance of the Digital Fabrication community as we work together to bring Printed Electronics to industrialization. This is the route to the meaningful and relevant standards we need to aid the "lab to fab" transition.

The gain for the individual from participation in this community is the chance to network with the growing community that is building around IEC TC119 and the liaison organisations that are associated with this task.

The route to joining this work is through your National Standards body.

References

[1] www.iec.ch/TC119.

[2] Adapted from "Welcome to the IEC", found under www.iec.ch/about/brochures/pdf/about_iec/iec_welcome_en_2010_lr.pdf

[3] www.ipc.org.

[4] IPC-2291, "Design Guidelines for Printed Electronics", www.ipc.org, (2013).

[5] www.iec.ch/TC91.

[6] IEEE Std 1620 "IEE Standard Test Methods for the Characterization of Organic Transistors and Materials" (2004).

[7] Reinhard Baumann, "Industrial Printing Beyond Color", IS&T NIP23 and Digital Fabrication 2007, pp 759 -761 (2007).

[8] Eloi Ramon, Carme Martínez-Domingo, Ana Alcalde-Aragonés, and Jordi Carrabina, "Inkjet Geometric Design & Compensation Rules Generation and Characterization", NIP28: International Conference on Digital Printing Technologies and Digital Fabrication, pp 308-311 (2012).

[9] See the IEC 60068 "Environmental Testing" series of standards.

[10] ISO 12635 "Graphic technology -- Plates for offset printing – Dimensions".

[11] I.M. Hutchings, G.D. Martin and S.D. Hoath, "High Speed Imaging and Analysis of Jet and Drop Formation", JIST 51(5), pp438-444 (2007).

[12] http://oe-a.vdma.org/en_GB/seite2.

[13] www.iec.ch/TC113.

Author Biography

Alan has a BSc in colorant chemistry and a PhD in instrumentation, both from the Department of Chemistry at the University of Manchester. After 22 years in the photographic industry Alan worked on consultancy projects that led him into Printed Electronics. In 2008 he joined 3M in the UK as Technical Development Manager, specialising in print solutions for high security documents.

He has served as session chair, short course instructor, and presenter at a number of IS&T conferences such as NIP, DF, Archiving, and ICIS; he was Short Course Chair for Archiving 2008. He is President of the IS&T.

Alan is active in Printed Electronics, both as a practitioner and Chair of IEC TC119 (Printed Electronics).