Future light technology and human health

University of Surrey, 21 -22 September, 2015

This unique multidisciplinary workshop brought together researchers working on the science and technology of developing light sources with life scientists exploring the effect that light has on humans, in terms of their alertness, performance, biological clock timing and sleep behaviour.

It was a timely event as 2015 was the UNESCO International Year of light (IYL) which was aiming to highlight the impact light has on our lives and thus was part of the UK IYL events. It also celebrated the success of the 2014 Physics Nobel Prize, which had been awarded to the inventors of the blue LED, which is the fundamental building block of all modern lighting.

It was organised by Dr Konstanze Hild, Advanced Technology Institute, Prof Stephen J. Sweeney, Department of Physics, Prof Debra J. Skene, Department of Biochemistry and Physiology and Dr Vikki L. Revell from the Surrey Clinical Research Centre all from the University of Surrey.

AIMS:

The development of solid state lighting has mainly been driven through the development of the GaN blue LED. Solid-state lighting promises to significantly reduce the energy cost of lighting over the next decades. However there are still scientific and technological challenges to better understand and improve these devices. In parallel with the development of solid-state lighting, researchers have identified that short wavelength blue light (contained within the blue LEDs that are used in solid-state lighting) is the most effective wavelength to affect circadian timing, sleep, alertness and performance. Current studies are aimed at optimising light environments for specific age groups (older people, adolescents) and determining the factors that drive the inter-individual variation in responses to light

At this stage, it was thus critical to bring the various communities that work in these fields (biologists, physicists, lighting engineers, clinicians) together to learn from one another and to better understand the broad effect that light has on human health and behaviour. This should lead to a better understanding of the properties of modern lighting required for health but also how challenges and opportunities in lighting design for varied applications can be met through interdisciplinary research

PROGRAMME AND DISCUSSIONS:

The workshop run over 1.5 days and participants were able to discuss each other's work over coffee and lunch on both days. The Monday evening event brought everyone together in a more informal setting at a dinner at the Weyside pub in Guildford. Overall there were 35 participants of which 7 were PhD students in different disciplines. The technical programme was arranged into 5 sessions: ***Setting the scene, Light and Health, Technological approaches, Light and Life, Technology, applications and standards*** followed by an ***open discussion***. There were contributions from industry (representatives of three different lighting companies were present), academia and civil service (through contributions from the

Department of Energy and Climate Change, Public Health England and the National Physical Laboratory). There were a total of 16 presentation of which 6 were invited. The invited speakers came from the UK, Switzerland and the Netherlands and were representative of the different research areas that the workshops was bringing together. The two broad areas of this workshop were the science and technology of light on the one side and the effect that light has on humans on the other.

In the first session of the workshop Prof Sir Colin Humphreys from the University of Cambridge gave an overview of: ***LED science and technology for solid-state lighting*** and Prof Rob Lucas from the University of Manchester explained: ***The neurophysiology of non-visual responses to light***. These both gave an excellent introduction to these two areas especially to the respective non-experts in those areas. Further talks on that day looked at the standards and the influence of lighting on health more generally and some more specific tools for looking at light exposure.

On the second day Prof Tao Wang from the University of Sheffield introduced the technology side by talking about: ***Semipolar InGaN LEDs with long emission wavelengths and high efficiency.*** This was then followed by some more talks on different ideas of fabricating LEDs and making them more efficient. Then Prof Anna Wirz-Justice, from the University of Basel, Switzerland gave and overview of: ***Why humans need light*** and what effect it has on them. Later Dr Luc Schlangen, from Philips Lighting, Eindhoven, gave the industrial perspective by presenting: ***Driving innovations in light: research and user insights for Human Centric Lighting applications.*** Both these were followed by some more talks in the area of lighting technology and the need of improvement for "circadian" friendly lighting before Dr Simon Hall from the National Physical Laboratory talked about ***Lighting Standards for SolidState Lighting*** from the perspective of metrology. This then led into a final open discussion of what is needed to drive this area forward. This final discussion continued the discussions that had already been going on during the workshop and focused on the issues of blue light, on ways of how to influence policy makers, on better light sources and overall on ideas for future collaboration.

OUTCOME AND FEEDBACK:

The feedback of participants was overwhelmingly positive and researchers in both fields stated that they genuinely learned and understood more about the challenges and the progress in each other's fields. Due to the nature of this interdisciplinary workshop no joint

publication was attempted but some of the work presented has since been submitted for publication. As a direct consequence from this workshop one of the participants (from Trilux Academy) organised an event in February 2016, which featured some of our workshops speakers and had Human Centric Lighting as a focus. Following the workshop, the University of Surrey in partnership with the Universities of Cambridge, Manchester and Strathclyde, together with input from NPL and Lumie Ltd, all of whom were present for the workshop, have submitted an outline EPSRC programme grant application to work on the development of new LED technology for applications in lighting. This is now being taken through to a full submission (c. £6M) in May 2016.

ACKNOWLEDGEMENT:

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