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Institute for Applied Ecology

Fraunhofer Institut Zuverlässigkeit und Mikrointegration

Adaption to scientific and technical progress under Directive 2002/95/EC

Stakeholder contribution for exemption 13

"Lead and cadmium in optical and filter glass"

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To whom it may concern

I should be delighted to make an assessment on the necessity to use Lead-doped glasses in optical systems to optimise the performance for different application areas. I am Professor and Director of the Fraunhofer Institute for Applied Optics and Precision Engineering in Jena.

The Fraunhofer-Gesellschaft is a government funded independent research institution and undertakes applied research of direct utility to private and public enterprise and of wide benefit to society. Research and development at the Fraunhofer Institute for Applied Optics and Precision Engineering (IOF) focus on optical systems technology with a view to continually improve the control of light. The Fraunhofer IOF is the competent partner to the local, national and international optics industry and is also a supplier to the public sector. The cooperative work in different competence networks and alliances ensures the successful operation in the market. The clients of Fraunhofer IOF come from the markets: information and communication, lighting, transport and traffic, production, medical technique, environmental and safety engineering. The work on contracts includes the development of prototypes and testing. More than 100 employees are working on problems related to optics and mechanics design.

Optical technologies are an enabler and catalyst for almost all branches. The invention of photonic technologies has had deep consequences and triggered a revolution in many fields of science and technology. These include for example spectroscopy, microscopy and imaging, astronomy, nonlinear and relativistic optics, and information processing.

Optical systems based on different refractive and diffractive components are key elements to *control light*. In order to realise highest spatial resolution in an optical image aberrations in the optical systems have to be corrected. Most important for advanced optical instruments like microscopes and spectrometers is the perfect correction of the chromatic aberration of any refractive element. If an optical system needs a colour correction, it is necessary to use special combinations of different high and low refractive index materials with specific dispersion characteristics to ensure a good quality over a broad spectral range. Today, there are numerous organic and inorganic materials with specific optical properties which have been developed in the past centuries to be applied for the chromatic correction.
However, if a broad spectral transmission from the ultraviolet to the near infrared spectral region is needed, there is no alternative in using dense flint glasses with Lead-doping as high-index material, because Lead-free systems have a reduced transmission between 410 ... 365 nm and are almost opaque below 365 nm. In consequence, important applications of modern microscopy in biology, medicine and drug discovery are excluded.

In addition, it has to be pointed out, that even if there is no specific requirement concerning the ultraviolet-transmission of the optics, in optics design applying Lead-free glasses a larger number of optical elements are necessary to reach the same performance of an optical system compared to systems based on high-index flint glasses. This contradicts the general trend to achieve compact and reliable systems with a small number of individual elements. In consequence Lead-free optical systems require more basic raw material. From the design point of view, the optical path length is increased, in particular the control of ultra short pulses to be used in Cornea keratectomy, laser surgery and micro-dissection or optical coherence tomography (OCT) is almost impractical.

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In conclusion, in view of the physical and technical limitations in optical technologies due to a general ban of Lead-doped glasses I strongly promote to establish an exceptional rule for the application of Lead-doped glasses in European optics industry.

Prof. Dr. Andreas Tünnermann