EDITORIAL SPECIAL ISSUE WOMEN IN GLASS

IJAGS

While the world is progressing towards gender equality and women's empowerment under the *Millennium Development Goals*, discrimination continues to exist in the scientific world. This discrimination takes many faces, but continues in many arenas to propagate the historic mistreatment of women. Rosalind Franklin obtained the first X-ray image of DNA but Watson, Crick and Wilkins received the Nobel Prize. Jocelyn Bell discovered pulsars but her PhD adviser was awarded with the Nobel Prize. And while Marie Curie twice won the Nobel Prize, only 3% of these prizes in medicine, physics or chemistry have been awarded to women, as evidenced most recently with the 2019 Physics awardee, Donna Strickland, being the first woman in almost 100 years. Hence, there is no doubt that under-representation, discrimination and lack of recognition of female scientists and engineers, continues to be present. As of March 8, 2020 there remains only one woman for every nine men in the elite of Western science. European and OECD women scientists occupy very few decision-making positions; their jobs are often evaluated more harshly; and, it is documented that they get less funding and fewer fellowships to investigate, while being paid salaries lower than those of their male colleagues at an equivalent educational and professional experience level.

The European Technology Assessment Network (ETAN) report, published in 2001 by the *Helsinki Group,* concluded that *the "under-representation of women threatens the goals of science in achieving excellence, as well as being wasteful and unjust."*[i]

A statistical review of the women in positions in higher education, research institutes and industry shows that, despite country-specific variations in systems and structures, the proportion of women in senior scientific and CEO positions is extremely small everywhere, further illuminating the gender segregation in the scientific field. The number of women in scientific careers shows a downward curve, with a continuous drop from the beginning of studies, where they tend to be the majority, to the higher rank of full professor, where the proportion of men is always much higher. This surprising snapshot is a constant across OECD countries. This situation, known as a "*scissor graphic,*" is described as a "*leaky pipeline,*" where women disappear from scientific careers disproportionately and constantly, resulting in the loss of many highly trained and talented women from the scientific workforce.[ii]

Following the UN Beijing Conference on women in 1995, the ETAN report highlighted the importance of ***"mainstreaming,"*** or ***integrating gender equality***, as a main policy to be implemented in science. The aim was to break the "**glass ceiling",** understood as a limit that prevents women from advancing to top positions in companies and R&D institutions.

The arguments in favour of having more women in research decision-making positions are abundant, from human rights and ethics to economics. Social justice and fairness are obvious, but there are also functional arguments, as research has demonstrated that:

- Diversity increases creativity, providing a substantially broader point of view, with more sensitivity and respect for different perspectives. This has been shown to be invaluable to any organization.

- Diversity increases quality. The more diverse the background and experiences of an organization's researchers, the less likely it's research is biased.

- Gender equality improves efficiency, as confirmed by the new orientation of universities towards business strategies. Many reports confirm the higher revenues and results in industrial companies including women in CEO or CTO positions.

The glass world is not an exemption. Women are often near half of the attendants to seminars, meetings and conferences, but they only represent a low percentage of invited talks and keynotes. A similar picture appears in special issues of journals where men are often if not always, overrepresented at levels proportional to their weight and relevance in the field.

It is a very difficult task to realize a state of female equality in single institutions; however, it is a goal organizations can strive for in a deliberative manner to achieve across our field - from academia to industry. However, such a multi-faceted challenge requires imagination and a concerted effort to define meaningful and useful tools in our toolbox, to lay a strong foundation that enables progress allowing women to achieve their full, and deserving, potential.

Our community, led by the International Commission on Glass (ICG) and in our project towards an ***International Year of Glass*** to be presented to the United Nations, aims to further focus on this issue. This goal can be achieved by recruiting top glass-women for committees, for plenary and invited talks, as well as CEO and Management Board level positions, and engaging the diverse network of women at all levels in our community who have worked within and are now entering, our community.

This special issue of **International Journal of Applied Glass Science (IJAGS)** is one such tool in our global toolbox where we have aimed to increase the visibility of women in glass science and engineering at all levels in their careers. We have identified and in this issue highlight a group of outstanding women researchers who are developing their careers in academia, government laboratories and industry in different countries and across a wide range of topics related to glass.

The issue includes 17 original articles with 53 authors; 13 were written only by women and 4 others are papers shared with 10 male colleagues. Authors coming from 12 different countries (including the US, Europe, Japan, Korea and China) contributed to this effort. Among the co-authors are PhD students, junior and senior researchers. We identified topics and worked to group authors across these varied states of their professional development. This has given rise to a globally representative issue with 17 articles on topics that span basic science on glass structure and crystallization mechanisms, to atomic simulation of structure and properties of glasses. These authors report on many different cutting-edge applications of glass, ranging from sealing glasses and glass-ceramics to components for batteries, phosphate glasses, fibres or biomaterials, with an emphasis on glasses for optics and photonics. Some of the papers are individual but most are co-authored-articles written by women from different institutions and countries enabling increased networking, an essential tool to build and expand the stated goals of ***mainstreaming and equality***.

To the best of our knowledge, this is the first time that a scientific journal in material science has dedicated a full issue to women researchers. We are thrilled to be the first and expect this is only the beginning of a new culture of integrating gender equality in the core of science world.

Educating companies and institutions in managing diversity, creating an engine for innovation and creativity, is the best route to a brighter future. Gender matters! Women are half of the world and must become half of the glass world. We hope we have laid the first brick towards this challenging but realizable goal.

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[i] European Commission (2000): *Science Policies in the European Union*. *Promoting Excellence through Mainstreaming Gender Equality*. A report from the ETAN expert working group on Women and Science.
[ii] Etzkowitz et al. *The Paradox of Critical Mass for Women in Science*. *Science*, vol. 266, 1994, 51-54