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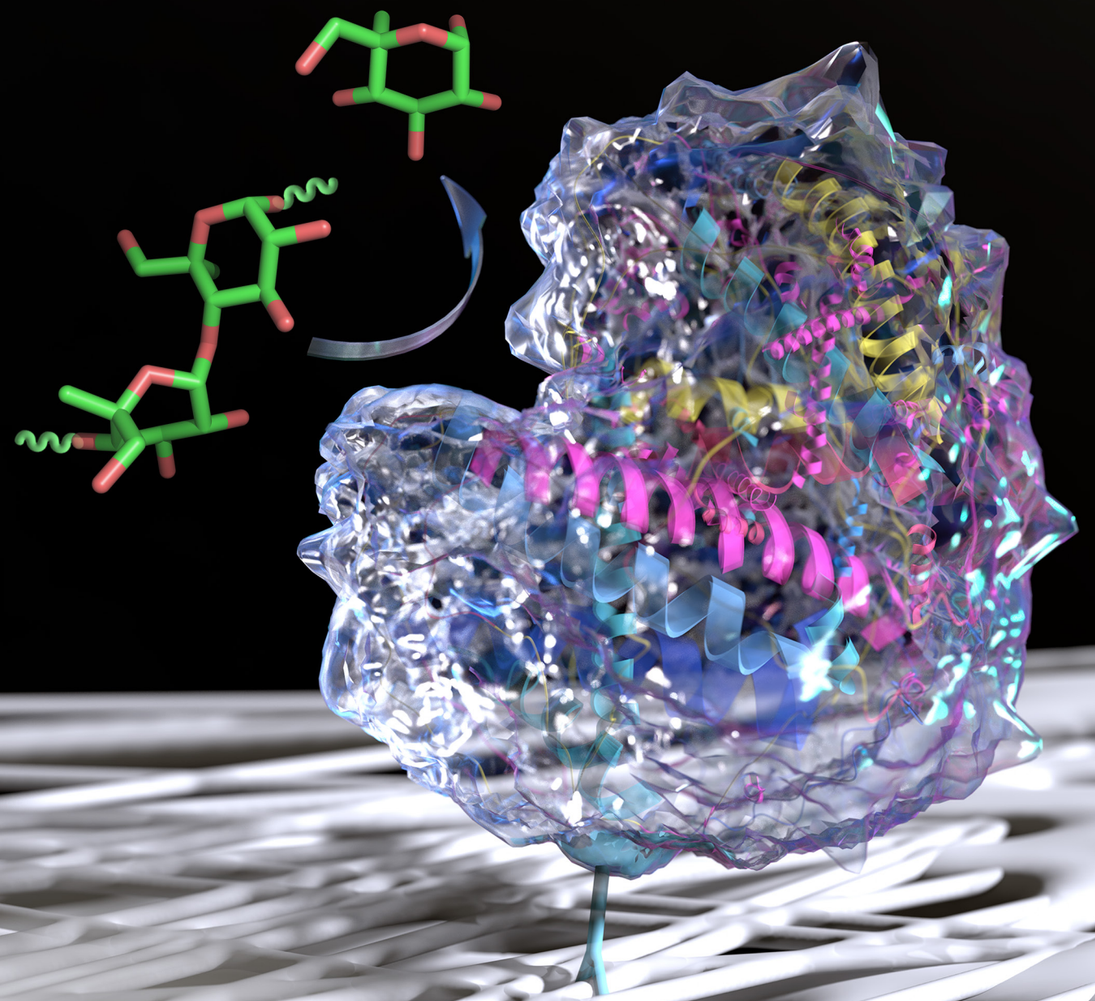

Research Article from Prof. Mark Moloney's group featured on cover of JOURNAL OF MATERIALS CHEMISTRY B

Prof. David Clifton awarded IEEE EARLY-CAREER AWARD

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Research Article from Prof. Mark Moloney's group featured on cover of Journal of Materials Chemistry B

OSCAR Deputy Director Professor Mark Moloney and Research Scientist Dr Dandan recently reported "Surface modified Materials for Active Capture of Enzymes" in the Journal of Materials Chemistry B, where the research was featured on the journal's front cover.

In the paper, the research team functionalized a glass fibre membrane surface with amino groups using a bisdiaryldiazo compound. With further treatment, the fibre surface was terminated with diazonium groups which were able to catch and covalently bind to an enzyme containing a tyrosine residue (e.g. cellulase). The catalytic properties of the enzyme were partially retained after being immobilized on the membrane surface, allowing for multiple uses.

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Surface modification of diverse materials by insertion of carbenes provides access to a variety of functional materials with adjusted chromophore, wettability, biocompatibility, crosslinking and adhesion properties. The researchers behind this work have earlier shown a successful surface modification of glass fibre membrane and tuning the surface functional groups with both different colours and wettability. Researchers were interested in investigating whether this carbene process might be successfully applied to

macromolecule (enzyme) capture (see Figure 1), and whether its loading level would give measurable and useful activity sufficient for bioengineering applications. Such an approach would be unique since it would provide a surface modification platform based upon carbene insertion for binding biomolecules, and the opportunity to use materials which have not been considered for enzyme immobilization previously. In the end, this idea proved to be very successful.

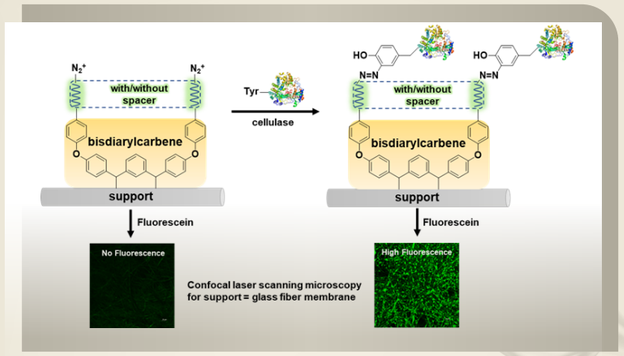


Fig. 1. Schematic illustration of carbene modified surface for enzyme capture and its confocal image after fluorescein addition

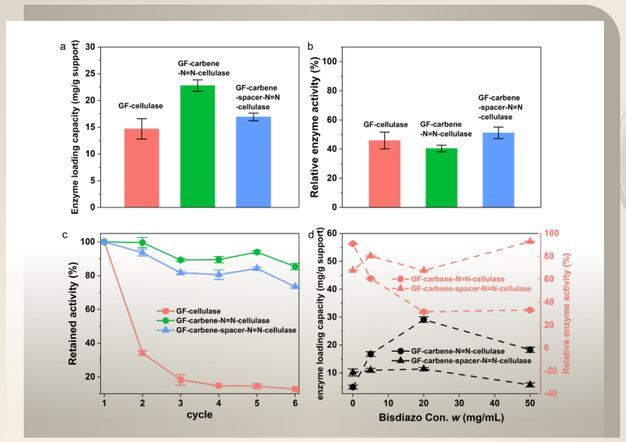


Fig. 2. Enzyme loading capacity, activity, reusability on modified GF membrane and optimization conditions

Five materials (polystyrene XAD4 bead, polyacrylate MAC3 bead, glass wool, glass fibre (GF) membrane, and polytetrafluoroethylene membrane) with different morphologies and surface chemistry were examined in detail as possible supports for cellulase immobilization using this common surface modification protocol. Of interest is that such covalently bound cellulase on modified GF membrane gave both the highest enzyme loading (~23 mg cellulase per g support), and retained more than 90% of activity after six cycles of re-use, compared with substantial loss of enzyme activity for physiosorbed cellulase after three cycles(see Figure 2). Optimization of the degree of surface grafting and the effectiveness of a spacer between surface and enzyme for enzyme loading and activity was conducted.

This work shows that carbene surface modification is a viable strategy for introducing enzymes onto a surface under very mild conditions and retaining a meaningful level of activity, and particularly, using GF membrane as a novel support provides a potential platform for enzyme and protein immobilization.

The full article is available online and in print: Moloney, Mark & Wang, Dandan & Hartz, William. (2023). Surface Modified Materials for Active Capture of Enzymes. Journal of Materials Chemistry B. 11. 10.1039/D2TB02550G.

Prof. David Clifton awarded IEEE Early-Career Award

The IEEE "Early Career Award" for 2022 has been awarded to Professor David Clifton, who runs the Digital Health lab at OSCAR. The IEEE is the "world's largest technical professional organisation", with over 400,000 members in 160 countries. This prize, given by the IEEE to one engineer each year, recognises "outstanding contributions in the field of biomedical engineering made by an individual within 12 years of their highest degree".

Prof. Clifton was presented with the prize after travelling to Israel to present the results of OSCAR research that was recently published in NeurIPS, which is "the equivalent of the journal Nature for machine learning research". This work, led by Fenglin Liu,a doctoral student in Prof Clifton's Oxford lab, during his research time in Suzhou, and involving Research Scientist Dr. Jessie Liu and then Senior Research Scientist Dr. Yang Yang from OSCAR, developed a system for helping to automate the process of writing letters for hospital patients – using "large language models", constructed using publicly-available medical data sources. The results are intended to give medics a "first draft" of letters to patients, so that a human can then make any necessary changes – a process that greatly improves upon the creation of letters "from a blank sheet of paper", which otherwise have an error-rate for the facts that they contain. The OSCAR model, published at NeurIPS and described in Israel, can drive down the error rates over human-produced letters, while maintaining high "fluency and readability" scores.

Prof. Clifton said, "I am extremely grateful for the nomination, which represents a team effort with my students and postdocs since 2010. The IEEE has been a fantastic supporter throughout my career, from undergraduate to graduate, through postdoc and on to being a member of faculty. The research environment at OSCAR is invaluable, because it allows one to collaborate across disciplines. I'm especially grateful to the senior committee within the IEEE for this nomination, because it represents the real-world impact that engineering can have on the world – in my case, on producing Digital Health systems for helping patients. For most researchers that join our team, their motivation is the promise of producing something that will make people's lives better."

OSCAR Academic Seminar series

On Friday 17th March, OSCAR held its 2nd Academic Seminar of the year. The symposium was the 16th intercontinental video conference to date, with participants from the UK, Europe, and China in attendance. Two PIs were invited to showcase their research while visiting OSCAR in March: (i) Professor Wei Huang, OSCAR PI in Engineering Biology, Professor of Biological Engineering & Fellow of St Edmund Hall, University of Oxford; and (ii) Academician Prof. Zhanfeng Cui OSCAR Director and PI in Engineering Science; Donald Pollock Professor of Chemical Engineering, Professional Fellow, Hertford College, University of Oxford. Deputy Director Professor Mark Moloney chaired the session.

Talk 1 – "Application of single cell Raman technology to life science and medical diagnosis".

Professor Wei Huang shared his expertise in Single-Cell Ramen spectra (SCRS) which provide a label-free biochemical profile of individual cells. He stated that these essential 'fingerprints' can be considered as the single-cell phenotype, reflecting gene expression, the metabolic functions, and revealing spatial and temporal relationships of cells. Sorting cells based on SCRS can link phenotypes to genomics, transcriptomics, and proteomics at the single-cell level. SCRS can use the natural Raman biomarkers of cells or stable isotope probing (SIP) to reveal cell metabolism and physiology.

Professor Wei Huang's research demonstrated that Raman biomarkers and Raman-activated cell sorting (RACS) can be applied to medical fields such as disease diagnosis, microbiome analysis, and antimicrobial resistance testing in a very rapid and efficient procedure, compared to conventional methods. In addition to this, it can be used for cell cultivation and single-cell genomics analysis in microbiology.

Talk 2 – "Bioreactors – From test tubes to Scaled Production."

Academician Professor Zhanfeng Cui introduced the design and operating principles of micro, small, conventional, and large-scale bioreactors, as well as the important applications of bioreactors.

The essence of this presentation gave the audience an understanding of the fundamentals of bioreactors, what they do, how they are applied and most importantly how engineers can support vital science to 'scale-up' (e.g. for large scale fermentation) and 'scale-out' (e.g. for autologous cell therapy).

Prof. Cui captivated the audience with many visual representations of simple and sophisticated bioreactors and their operation in some essential real-world processes. Prof. Cui illustrated some key issues and methodologies for translating bioscience research to industrial and clinical applications. Prof. Cui said, "As long as scientists and engineers work together, the development of biotechnology processes and biological products can be accelerated…"

He rounded off the seminar stating: "the simple approach, doesn't necessarily equal a non-professional approach. If simple can do, why make a process complicated!"

Marking International Women's Day: OSCAR gets staff talking about #EmbraceEquity

The theme for 2023 **INTERNATIONAL WOMEN'S DAY** is #EmbraceEquity. It calls for the understanding of the difference between 'equity' and 'equality' and being a part of a global effort to forge an inclusive world.

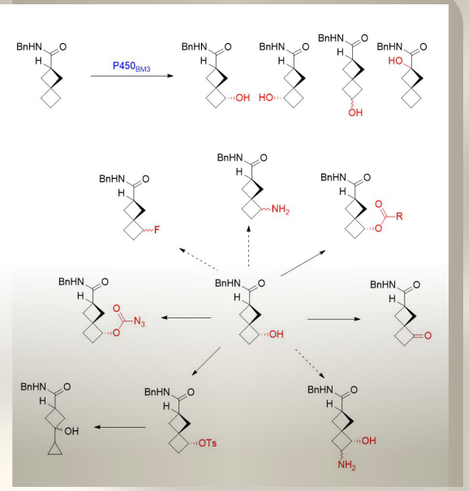
OSCAR opened a discussion among the staff on #EmbraceEquity on 8th March, where personal experiences were shared along with practical ideas and ambitions for supporting equity and inclusion.

The discussion continued in the OSCAR's Women's Day media campaign 'OSCAR She Says'. This year, Research Scientists Dr. Xinxin Zhang and Dr. Henan Zhan, and Research Technician Wenwen Tao were invited to share their take on #EmbraceEquity.

"Dr. Xinxin Zhang: 'My choice to pursue a scientific path is all about passion and scientific literacy, not gender.'"

Dr. Xinxin Zhang has a PhD from Prof. Robertson's group and was a member of Wolfson College. Her DPhil project focused on target molecule synthesis via P450 mutants as hydroxylation catalysts to achieve high regio-/stereo-selectivity. She joined OSCAR in 2022 and continued her research in Prof. Robertson's group, currently focusing on the selective hydroxylation of spiro molecules and their diversification.

Q: Can you tell us about your research at OSCAR and progress achieved so far?



P450 enzyme catalyzed hydroxylation products and their derivatives

Xinxin Zhang: Here in OSCAR, we aim to develop a $P450_{BM3}$ mutants mediated hydroxylation method with high regio- and stereo-selectivity. Further diversification of these hydroxylated molecules would generate a library of fragment molecules that could be used as building blocks or drug intermediates that could meet the need of researchers or pharmaceutical companies.

The molecule that I'm currently working on is the hydroxylation and diversification of spiro[3.3]heptane-2-carboxamide and we have now found mutants with high selectivity under several rounds of optimisation. With our method, not only are we creating a library of fragment molecules but also generating a library of $P450_{BM3}$ variants for general hydroxylation of small organic molecules by docking-guided mutagenesis.

Q: What is your take on #Embrace Equity theme? As a female scientist, how do you think you personally can contribute to this issue?

Xinxin Zhang: Equity is that a person is perceived and evaluated not on the basis of gender, race, or other identifiers, but on the basis of their own circumstances, qualities, and the reality they currently face. Equity is only true when it is possible to talk about equity regardless of gender. Therefore, when a society or a community says it wants to support and help women and people, it shall ultimately be about removing potential barriers for each individual to achieve their potential, and giving them a fair chance to compete, rather than talking about gender differences in general.

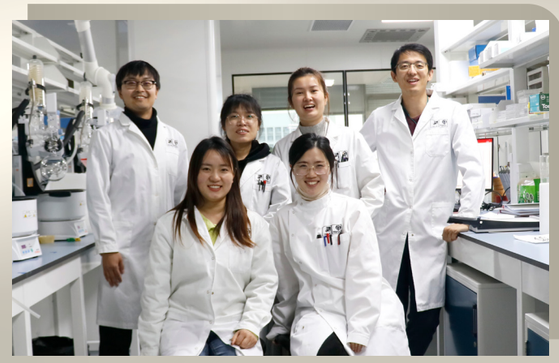
As a researcher, I think the main thing I can do to support issues of "equity, inclusion and diversity" is that if I am fortunate enough to go further in research, I will always be sure that it is my passion for research and my own scientific literacy that are driving me forward, rather than my or society's attempts to prove to everyone that women can do scientific research.

Q: Have you been treated fairly as a woman? Do you think that OSCAR provides an inclusive environment and culture that supports and celebrates women's career development and achievements?

Xinxin Zhang: I think that after answering the previous question, it is difficult for me to discuss the gender-specific question of whether I have been treated fairly as a woman. I can only say that I have been very lucky in my study and work, and have not felt

treated differently or unfairly. But my good fortune must not erase the fact that some people have experienced, or are experiencing, inequalities such as gender discrimination or pay gap.

Therefore, I think it is even more important for me to pay a warm tribute to OSCAR for its ongoing support for each and every employee's scientific research and career development as well as its tolerance and respect for differences. OSCAR has indeed done its best to be thorough and considerate. Meanwhile, the staff at OSCAR also respect each other and help each other out. I am grateful for OSCAR and for all that I have because of OSCAR.



Xinxin and her colleagues at OSCAR

> "
> **Dr. Henan Zhan: 'Only when we strengthen ourselves can we help others in need.'**
> "

Dr. Henan Zhan achieved her PhD degree in 2020 at Radboud University Nijmegen, majoring in bio-inspired hydrogel composite for mimicking the extracellular matrix environment. She joined OSCAR in 2021 and is currently working on a project to establish a platform for biomaterials storage.

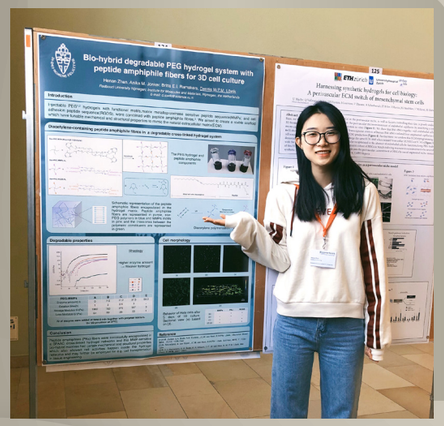
Q: Can you tell us about your research at OSCAR and progress achieved so far?

Henan Zhan: For most biomaterials like enzymes and vaccines, it's hard to retain their activity in normal conditions, and the storage period within the active range is relatively short. My

research is to facilitate biomaterials storage with lyophilization technique, prolonging the storage time, and reducing the cost of storage and transportation while maintaining activity.

I have successfully freeze-dried enzyme and protein preparations, which facilitates the team's subsequent testing and experimental purposes.

Q: What is your take #Embrace Equity theme? As a female scientist, how do you think you personally can contribute to this issue?

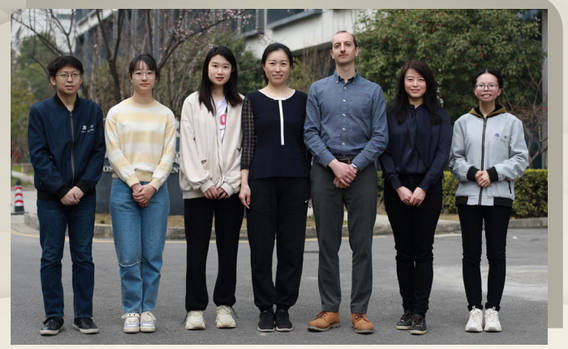


Henan Zhan: Equality and Equity are really two concepts that need to be distinguished. We talk about equality but ignore individual differences most of the time. There are many other factors, not just gender, that make people's starting lines and racing tracks in life non-universal.

I think being a female scientist itself is a kind of diversity. Being fair is more about providing more opportunities for people to try and find a more suitable path. I think the first thing to do to "Embrace Equity" is to bring out the best in you, treat your job and research seriously. Only when we strengthen ourselves can we help others in need.

Q: Have you been treated fairly as a woman? Do you think that OSCAR provides an inclusive environment and culture that supports and celebrates women's career development and achievements?

Henan Zhan: To be honest, I have been on a relatively smooth path along the way, both doctoral interviews and job interviews. I don't have any experience of being treated differently because of my gender, which is kind of a fair treatment experience, I guess.



Henan and her colleagues at OSCAR

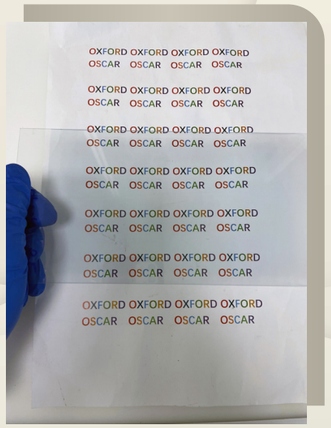
I think OSCAR's working atmosphere is very friendly and free, people here are ready to help you solve problems. The proportion of women staff in both administrative departments and my research group is high, so we can see more possibilities here and get relevant assistance and support.

" Wenwen Tao: 'Explore Every Tiny Breakthrough with a Deep Commitment to Professionalism.' "

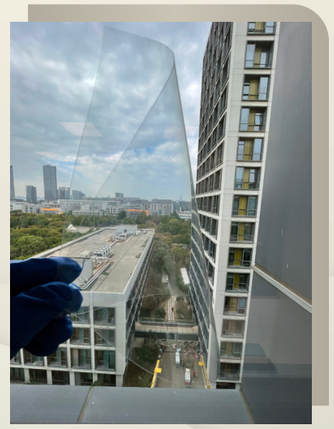
Wenwen Tao received her Master's Degree in Materials Science and Engineering from the Institute of Functional Nano & Soft Materials at Soochow University in 2020. While studying for her Master's Degree, she worked on the design and synthesis of thermally activated delayed fluorescent materials and their application in organic light-emitting diodes. She joined OSCAR in 2020 and is currently focusing on the development of transparent conductive polymer films and their commercial application.

Q: Can you tell us about your research at OSCAR and progress achieved so far?

Wenwen Tao: Our optoelectronics team has developed a conductive film based on polyethylene-dioxythiophene (PEDOT), a new generation of flexible and transparent polymer-based conductive films. By adjusting formulations and preparation processes, its square resistance can be continuously adjusted from



PEDOT film on glass substrate



PEDOT film on PET substrate

tens to tens of thousands of ohm per square, and its transmittance can be continuously adjusted from 80% to 99%, making its conductivity and transmittance comparable to those of current commercial transparent conductive materials.

Meanwhile, we have achieved in-situ film polymerization in a single step by using the solution-based film formation at low temperature. In addition to the simple preparation process, it is compatible with industrial grade printing technology.

The transparent conductive polymer film we have developed offer the advantages of low cost and sound flexibility to directly address the needs of our customers for flexible electronics and wearable electronics. These films can be used in display devices, electrochromic devices, touch switches and other related applications.

This technology is currently patent pending for invention, and our team is actively promoting its commercial application.

Q: What is your take #Embrace Equity theme? As a female scientist, how do you think you personally can contribute to this issue?

Equality and equity, as I understand, has nothing to do with gender, but more to do with individual differences. Everyone has equal opportunities and rights. On this basis, we observe, respect and understand the differences and diversity of individuals, and courageously pursue equity as a way for society to respect and embrace all individuals.

Our society now understands, recognizes and values the difference between "equality" and "equity", and encourages all women to embrace equity, so that all women can achieve their potential and realize their innate qualities in different positions, and work together to shape a tolerant and harmonious world. This is a step forward for both society and us.

As one of thousands of female scientists, I think that we shall give full play to our strengths with a deep commitment to our professionalism, explore every tiny breakthrough, and strive to create every value to allow the society to see and recognize the power of women. This is a contribution to science and society, and a contribution to embracing equity.

May you and I be independent and equal, embrace equity, and shine brightly with flowers in our hands!

Q: Have you been treated fairly as a woman? Do you think that OSCAR provides an inclusive environment and culture that supports and celebrates women's career development and achievements?

I feel very lucky that I have always been treated fairly, both at school and at work. I wish all women were so lucky to have this in their work and in their lives.

We have very few women in our team but I have always been able to feel the respect and understanding, equity and tolerance that everyone has shown me. I would like to express my gratitude for the very friendly working atmosphere that OSCAR and the Optoelectronics Technology Lab provide for their employees. Here, the diversity of every employee is respected and tolerated, and we help each other and make things happen.

Wenwen and her colleagues at OSCAR

During my time at OSCAR, I have been able to experience and enjoy the inclusive culture and environment that OSCAR provides for women. For example, "She Says" brings the voice of women into the community, which has gone a long way to encouraging and supporting the development and achievements of women's careers.