

Polymer Science in South Africa

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Polymer science and technology now impact all spheres of this age's everyday life, from packaging, water purification materials, health, agriculture, transport and electronics. The wide applicability of polymers leverages the unique physicochemical properties of these macromolecules, the vast array of available building blocks and a stocked synthetic toolbox for accessing polymers with differing functionalities, topologies and architectures. Polymer science is a mature field, with a unique balance between fundamental research and applied science, and a significant involvement of commercial companies. The polymer industry is an important cornerstone of South Africa's highly diverse and complex chemical industry.^[1] In addition, South Africa has fairly comprehensive polymer science teaching and research programs.^[2] This special issue, "Polymer Science in South Africa" comprises 16 open access research articles, i.e., 10 experimental papers and 6 review articles from the South African polymer science community. Research areas covered include polymer analysis, polymer engineering, materials for health and biotechnology, degradable polymers and environmental impacts of polymers materials; these contributions are summarized below.

Advances made in the analysis of complex polymers are summarised in Pasch's review article ([mame.202300354](https://doi.org/10.1002/mame.202300354)), shedding light on challenges encountered in polymer analysis due to their heterogeneity in molar mass, end-group functionality, microstructure and topology. This contribution contains a significant amount of research work sponsored by SASOL, highlighting an important synergy between industry and academia in South Africa. Van Reenen and co-workers ([mame.202300372](https://doi.org/10.1002/mame.202300372)) investigated the applicability of solid state NMR spectroscopy in determining the oil content of commercial waxes, in order to help the

industry develop alternative approaches for assessing the quality of waxes. Mhlabeni et al. ([mame.202300125](https://doi.org/10.1002/mame.202300125)) also investigated the phase behaviour of blends comprised of Fischer-Tropsch wax and linear low density polyethylene and found that the two were fully miscible in the melt and partially cocrystallized in the solid state. The review by Orasugh and co-workers ([mame.202400104](https://doi.org/10.1002/mame.202400104)) highlights the development of flame-retardant polyethylene composites from processing to final materials.

Polymers have numerous biomedical applications, such as tissue engineering scaffolds, wound dressing devices, drug delivery materials, medical implants, biosensors, and filtration devices. Motlounge et. al., ([mame.202300457](https://doi.org/10.1002/mame.202300457)) developed a smart hybrid gel with tuneable mechanics and de-swelling kinetics, as well as excellent injectability and self-healing capabilities, suitable for application in biomedicine. Mhike and co-workers ([mame.202400130](https://doi.org/10.1002/mame.202400130)) reviewed advances in the use of electrospun polymeric nanofibers in controlled release devices for mosquito repellents. The review by Mtibe and co-workers ([mame.202300388](https://doi.org/10.1002/mame.202300388)) also covers recent advances in the use of electrospun polycaprolactone nanofibers for biomedical applications. Drug-resistant bacteria are becoming an increasing threat, and polymeric materials are postulated to be less susceptible to the development of resistance than antibiotic drugs. Motivated by this, Daniels et al. ([mame.202400071](https://doi.org/10.1002/mame.202400071)) developed a 3D printable antimicrobial polymer blend, and showed that the printed parts kill *S. aureus* on contact.

While polymers have helped to simplify many aspects of everyday life, their negative effects on the environment are increasingly apparent. Plastic waste materials are increasingly found everywhere in the biosphere. As a result, there is a greater urgency to address this by increasing research into the development of environmentally friendly plastics. The South African Polymer science community is alive to this challenge. In this special issue, several contributions demonstrate the use of biobased and/or biodegradable materials, polymer recycling and the incorporation of bioderived nanomaterials into smart materials. For example, Masanabo et al. ([mame.202400037](https://doi.org/10.1002/mame.202400037)), as well as Ray and co-workers ([mame.202300293](https://doi.org/10.1002/mame.202300293)) demonstrate the production of biodegradable biocomposites, for packaging applications, using biobased sources. Matumba et al. ([mame.202400056](https://doi.org/10.1002/mame.202400056)) review the applications of compostable polyester blends.

Recycling offers a route to managing plastic waste. South African policymakers have set a target of 60% of plastic waste to be recycled, from 2025.^[3] However, as Matthews et al. ([mame.202300421](https://doi.org/10.1002/mame.202300421)) show, weathering-induced degradation reduces the number of times some commonly used polyolefin plastics can be recycled, presenting a challenge for the uniform application of this legislation. The contribution by Hlangothi and co-workers ([mame.202300410](https://doi.org/10.1002/mame.202300410)), is also on the theme of polymer material waste management, i.e., tyre waste. Specifically, they investigate the incorporation of devulcanized tyre rubber into natural rubber and styrene butadiene rubber blends to develop materials which

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can be tailored for specific applications. A viable approach for recycling pre- and post-3D printing waste was also demonstrated ([mame.202300276](https://doi.org/10.1002/mame.202300276)), and 3D printing filaments produced from both waste PLA filaments and blends of virgin and waste PLA filaments showed excellent printability.

Polymer materials are also used to mitigate other forms of environmental waste, for example, removing inorganic micropollutants from wastewater. Setshedi and co-workers ([mame.202300392](https://doi.org/10.1002/mame.202300392)) prepared composites of polypyrrole and granulated activated carbon and used these to remove chromium from a real wastewater effluent from the ferrochrome industry. Matabola et al. ([mame.202300390](https://doi.org/10.1002/mame.202300390)) also review the use of polyvinylidene fluoride-based composite materials in treating oily wastewater.

We are excited by the quality of work presented in this issue, covering a wide range of research areas in polymer science, including polymer analysis, biomedical polymers, polymer engineering and sustainability. Fewer contributions, however, incorporate synthetic polymer chemistry; we hope in future we will see

more growth in this area, along with continued growth in polymer science research, in South Africa, as a whole. We would like to express our heartfelt gratitude to the many researchers and authors who contributed and whose dedicated efforts made this special issue a reality. We hope this special issue will give readers an insight into our polymer science community and engender new and fruitful collaborations with partners in South Africa and beyond.

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