

Design, Synthesis and Characterization of 1,3,5-Triaminotriazine and Oxalic/Succinic acid condensed polyamides

Karunanithi Suganya^{1,*}, C. Anbuselvan¹, D. Hemamalini¹ and Dhurairaj Satheesh^{2,*}

¹Department of Chemistry, Presidency College (Autonomous), Chennai – 600 005, Tamilnadu, India.

²PG and Research Department of Chemistry, Loganatha Narayanaswamy Government College (Autonomous), Ponneri – 601 204, Tamilnadu, India.

**Corresponding author(s) email: suganyakarna4@gmail.com; satheeshvdm@gmail.com*

INTRODUCTION

- ❖ Melamine-based polyamides are high-performance polymers containing melamine (triazine ring) and amide linkages.
- ❖ They exhibit excellent thermal stability, mechanical strength, chemical resistance, and flame-retardant properties.
- ❖ Their unique structure makes them suitable for various industrial, environmental, and biomedical applications



AIM & OBJECTIVES

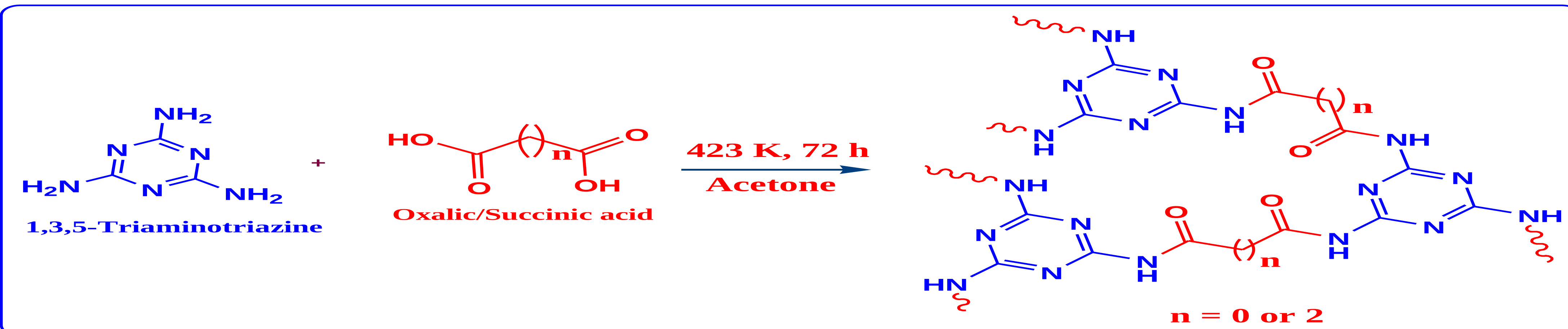
Aim:

- ❖ To synthesize and characterize novel melamine-based condensed polyamides derived from melamine and dicarboxylic acids (oxalic acid and succinic acid).

Objectives:

- ❖ Synthesize polyamides by condensation polymerization.
- ❖ Prepare polymers with different monomer ratios.
- ❖ Characterize using UV-Vis, FT-IR, NMR, and SEM.
- ❖ Confirm polymer structure and morphology.
- ❖ Explore their potential for advanced industrial and environmental applications.

SYNTHESIS

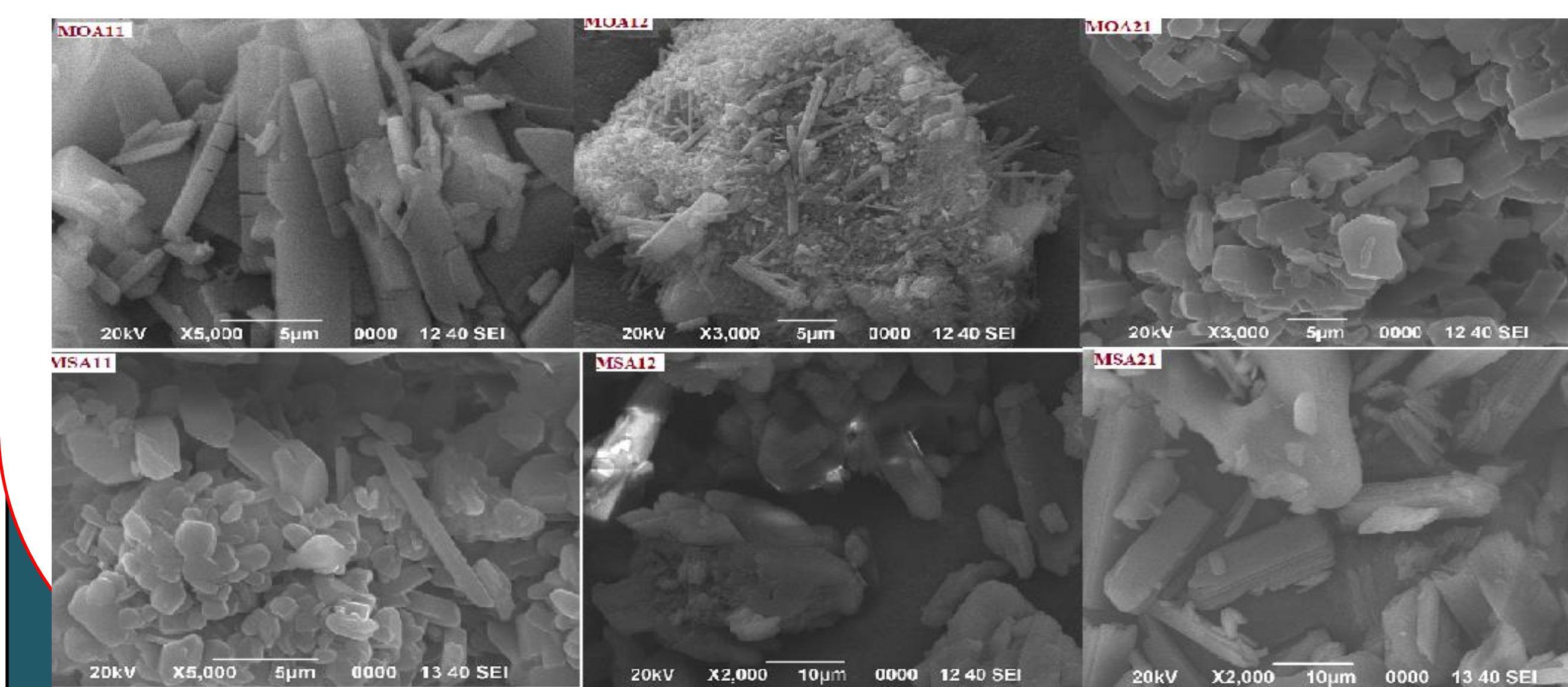


SPECTRAL STUDY

- ❖ The UV–Visible spectra of the synthesized melamine-based polyamides (MOA11, MOA12, MOA21, MSA11, MSA12, and MSA21) were recorded in the wavelength range of approximately 200–800 nm.
- ❖ The spectra showed a strong absorption band in the UV region, mainly between **220 and 260 nm**.
- ❖ The intense absorption observed in the **220–240 nm region** can be attributed to $\pi \rightarrow \pi^*$ electronic transitions of the conjugated **triazine ring (melamine moiety)** and amide chromophores present in the polymer backbone.
- ❖ In FT-IR, the appearance of a strong absorption band around **1650–1680 cm^{-1}** confirms the formation of **amide (–CONH–) groups**.
- ❖ The characteristic **s-triazine ring vibration near 810–830 cm^{-1}** indicates the presence of the melamine moiety in the polymer backbone.
- ❖ The reduction or disappearance of free amine and carboxylic acid bands compared with the monomers suggests successful condensation between melamine and the dicarboxylic acids.
- ❖ The broad N–H stretching band observed around **3300–3400 cm^{-1}** may be attributed to intermolecular hydrogen bonding within the polymer network.
- ❖ In NMR, broad resonances observed in the **6–10 ppm** region indicate the presence of hydrogen-bonded amide NH groups.
- ❖ For MSA polymers, signals around **2.2–2.8 ppm** correspond to methylene (–CH₂–) protons from the succinic acid segment.
- ❖ The appearance of carbonyl carbon signals in the **160–170 ppm** region confirms the formation of amide linkages.

MORPHOLOGICAL STUDY

- ❖ The **MOA polymers** generally exhibit more pronounced crystalline plate-like and needle-like structures, indicating stronger rigidity arising from the oxalic acid-derived polymer backbone.
- ❖ The **MSA polymers** show flake-like, block-like, and aggregated morphologies due to the flexible aliphatic chain of succinic acid. Morphological variations among MOA11, MOA12, MOA21, MSA11, MSA12, and MSA21 confirm that the monomer ratio significantly influences crystal growth, particle aggregation, and surface texture.
- ❖ The observed rough and porous surfaces may be advantageous for applications in coatings, adsorption, membrane materials, and composite reinforcement.



CONCLUSION

- ❖ Novel melamine-based polyamides were successfully synthesized using oxalic acid and succinic acid.
- ❖ UV–Vis, FT-IR, and NMR analyses confirmed the formation of amide-linked polymer structures. SEM studies revealed diverse crystalline morphologies influenced by monomer ratios.
- ❖ The polymers exhibited good structural integrity and organized microstructures. These materials possess potential applications in coatings, membranes, flame-retardant systems, composites, and environmental technologies.
- ❖ The study demonstrates the feasibility of developing advanced melamine-based functional polymers through simple condensation polymerization.

ACKNOWLEDEMENT

- ❖ The authors thank Project Guide, the Principal, Head of the Department and staff members, Department of Chemistry, Presidency College (Autonomous), Chennai-600005, Tamilnadu, India.
- ❖ The authors also thank the VIT University, Vellore and SAIC, Tezpur University, Assam for spectral and morphological studies