# Synthesis and characterization of acrylamide-based polyelectrolytes bearing long alkyl spacers

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- ✓ Polymerizable in common organic solvents
- ✓ Controlled deprotection via saponification
- ✓ Copolymerization

## Conclusion

11–Aminoundecanoic acid is converted efficiently into the monomer methyl 11–acrylamidoundecanoate. The protecting methyl group enables radical polymerization in common organic solvents and controlled liberation of the carboxylic acid by saponification. The obtained protonated acid can be modified with various counter ions. The successful copolymerization with *N,N*-dimethyl acrylamide gives a more flexible polymer, which is advantageous in thin film formation.

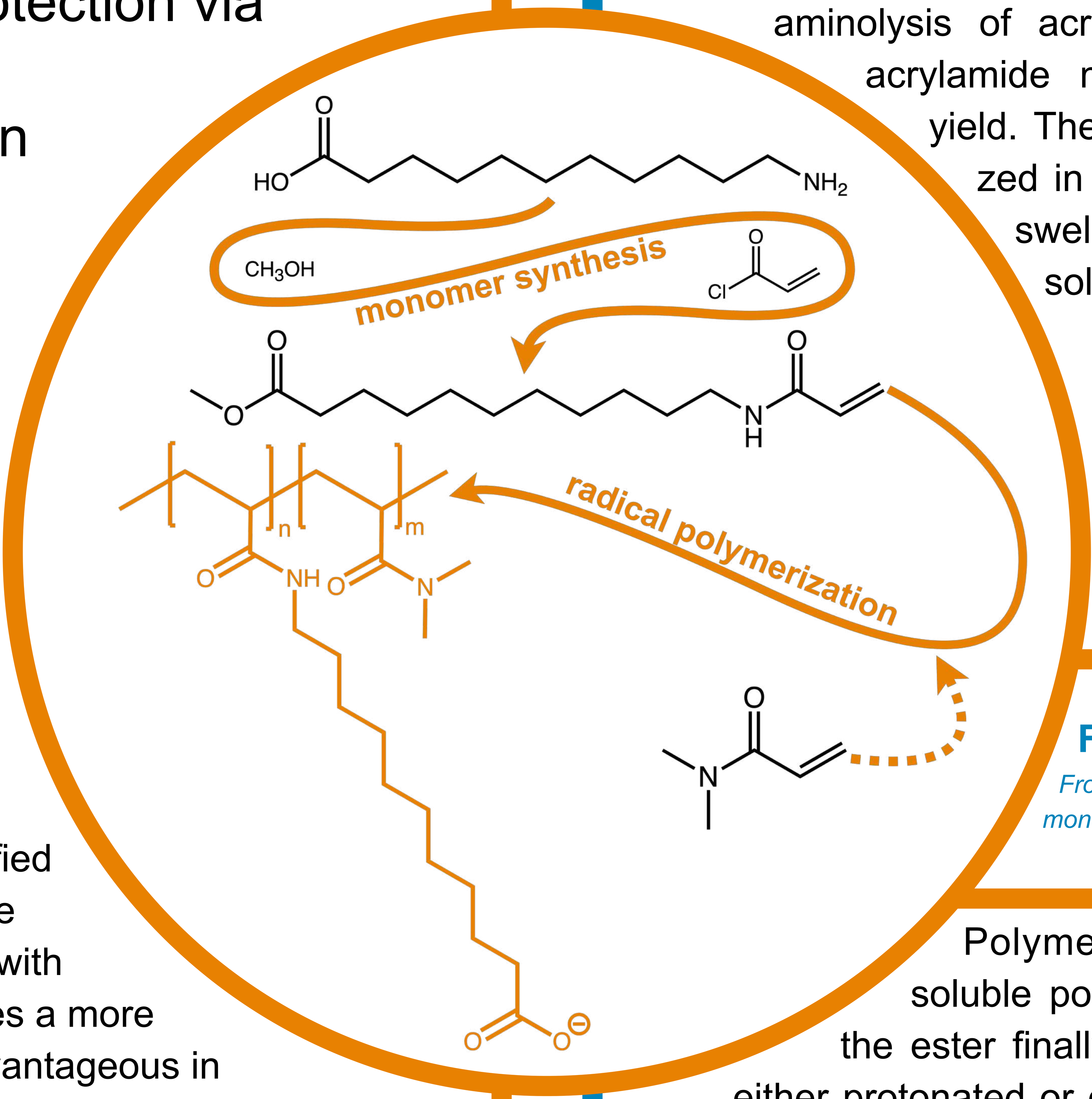


**Fig. 1 Visual abstract**

*From the starting material via the monomer to the homo- and copolymers.*

## Introduction

The potential applications of polyelectrolytes are very broad. They are already industrially used in the field of enhanced oil recovery[1] and water treatment[1]. Further uses in battery technology[2], sensor design[2] and drug delivery[3] are currently under investigation and in development. This work represents a new perspective on the concept of polyacids with the inclusion of long aliphatic spacers, to obtain flexible ionic groups. The secondary structure of the (co)polymers are also of high interest due the possibility to be highly ordered through hydrogen bonding. This should enable new material properties, beneficial in the before mentioned uses.

## References

[1] Mortimer D.A., Polym. Int., 1991, 25, 29

[2] Di Noto V., Lavina S., Giffin G. A., Negro E., Scrosati, B., Electrochimica Acta, 2011, 57, 4

[3] Zhang S., Bellinger A., Glettig D., *et al.*, Nature Mater, 2015, 14, 1065

## Results and Outlook

The efficient conversion of 11-aminoundecanoic acid into the corresponding methyl ester and the subsequent aminolysis of acryloyl chloride leads to the acrylamide monomer with 80% overall yield. The monomer can be polymerized in bulk, which results in strong swelling behavior in chlorinated solvents (Fig. 2).

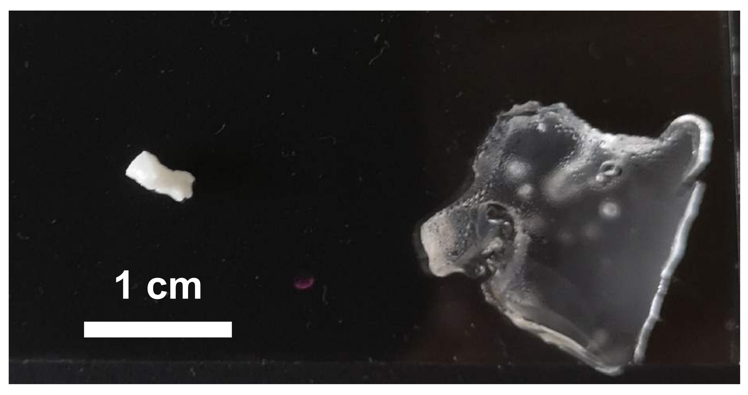


*Fig. 2 - Swelling behavior in water (left) and dichloromethane (right).*

Polymerization in solution gives soluble polymers and saponification of the ester finally yields the polyelectrolyte - either protonated or converted into different salts. The solubility is directly dependent on the pH (Fig. 3). The random incorporation of the comonomer *N,N*-dimethyl acrylamide allows film formation. The synthesized polymers are currently characterized further to learn more in terms of secondary structure, ionic conductivity and possible use cases.

*Fig. 3 - The change of polymer solubility with the addition of a drop of hydrochloric acid to an alkaline polymer solution.*

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