Tricyclononenes: New Alicyclic Monomers for 157 nm Photoresists

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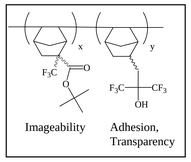
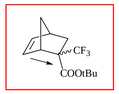
Norbornene Copolymers for 157 nm Photoresists



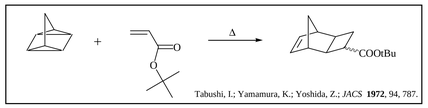
Features of Norbornene Copolymers
α–trifluoromethyl group increases transparency αof the ester



Unfortunately,
Proximity of strongly electron withdrawing groups deactivates olefin towards polymerization

∴ Monomer difficult to polymerize using cationic nickel and palladium catalysts

Tricyclononene Chemistry



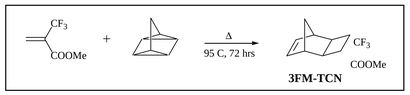
Benefits of TCN Chemistry:

Electron withdrawing groups positioned further away from double bond

Easy synthesis and purification

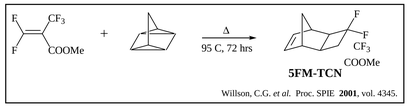
Compatible with a wide range of alkene and alkyne starting materials

Fluorinated TCN Monomers



Isolated yield: 80-90%

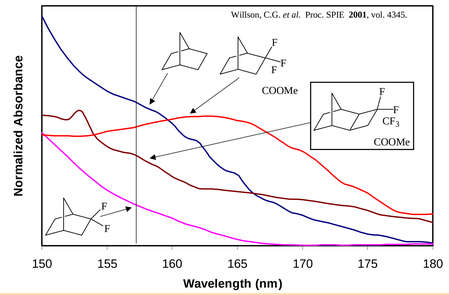
Clean reaction, high yield, easy purification



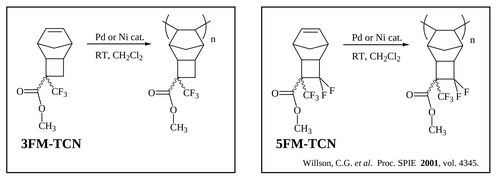
Isolated yield: 20%

Higher fluorine content…but lower yield
Currently, optimizing conditions to improve yield

Gas Phase V-UV Spectra



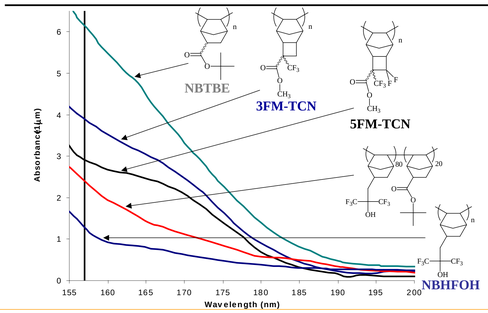
Successful Synthesis of TCN Model Resist Polymers



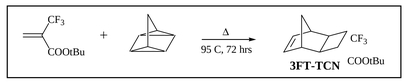
TCN framework allows polymerization of monomer containing the α-CF_3/t-butyl ester functionality

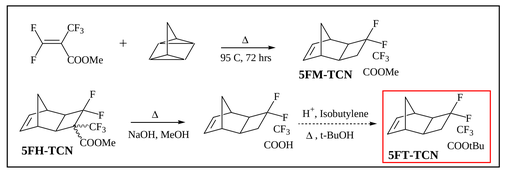
Polymerization and work-up identical to norbornene-based vinyl addition polymers

VASE Analysis of Polymers

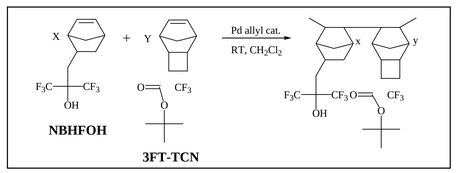


Fluorinated TCN Monomers Synthesis





TCN Copolymers for 157 nm Photoresists

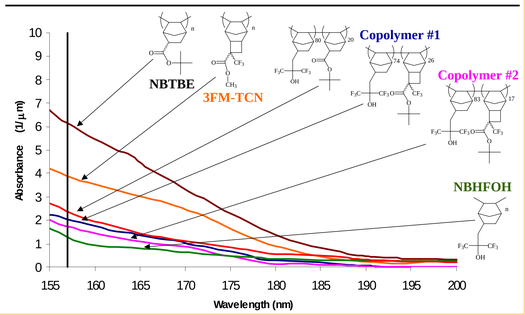


α–trifluoromethyl group increases transparency of the ester

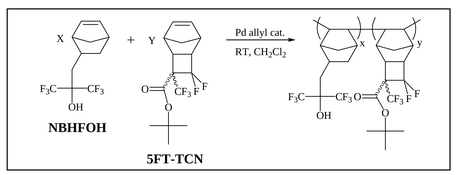
TCN framework allows for facile polymerization of monomer containing the α-CF_3/t-butyl ester functionality

Copolymerize with hexafluoroisopropyl alcohol-functionalized norbornene for increased transparency and adhesion

VASE Analysis of TCN Copolymers



Coming Attractions



Increased fluorine content decreases absorbance of ester monomer at 157 nm

Expect significant increases in transparency of copolymers of 5FT-TCN compared to copolymers with more heavily absorbing 3FT-TCN.

Working on scaling-up polymers for image work

Conclusions

Tricyclononene monomers offer a route to vinyl addition polymers containing esters with α-CF_3 groups.

V-UV and VASE analysis on model monomeric and polymeric TCN systems indicate promising transparency at 157 nm.

Functional resist copolymers using TCN monomers show good transparency at 157nm and are being evaluated for imaging performance.

More heavily fluorinated TCN copolymers are being synthesized with the potential for increased transparency.

Additional TCN-based monomers are being evaluated for resist comonomers.

Acknowledgements

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