

# **Ullman-Type Coupling of Functionalized 1,2,4-Bistriazinyl-Bipyridines toward Strategic Complexants for Minor Actinide Separations**

Gabrielle Waters

TTU Chemical Engineering

The potential for nuclear fuel to be a sustainable source of energy is predicated on the prospective remediation and recyclization of spent nuclear fuel. Thus, fully closing this linear process would dramatically decrease the volume of radiotoxic waste and operating cost of mining fresh uranium or transformation of fissile materials. Minor actinides present in spent nuclear fuel do not make up a large portion of the fuel; however, these highly radioactive and unstable nuclides, as well as the neutron-absorbing lanthanides, are the main reason behind the inability to reuse spent nuclear fuel. At this time, spent nuclear fuel that contains radioactive minor actinides has the potential to be separated using liquid-liquid extraction techniques being facilitated by lewis-basic heterocyclic complexants that possess minor actinide binding affinity. Therefore, complexants, such as bis-triazinyl-bipyridine (BTBP) scaffolds, present possible advantages for liquid-liquid separations of minor actinides. Previous work in our lab focused on traditional condensation techniques to afford symmetric complexants. Our current work is centered on convergent strategies with modular synthons to afford symmetric and unsymmetric BTBP scaffolds. Our approach to the synthesis of BTBP scaffolds involves an optimized metal-mediated Ullman-type coupling of two 3-(6-bromo-pyridin-2-yl)-5,6-diphenyl-[1,2,4]triazine (MTP) scaffolds. Further functionalization on BTBPs, as well as broadening the scope to pyridinyl substrates, has been successful with these conditions. Additional substrate scope will focus on the synthesis of unsymmetric functionalized BTBP scaffolds. Method optimization, experimental procedures, substrate scope, purification analysis, and future goals will be disseminated.