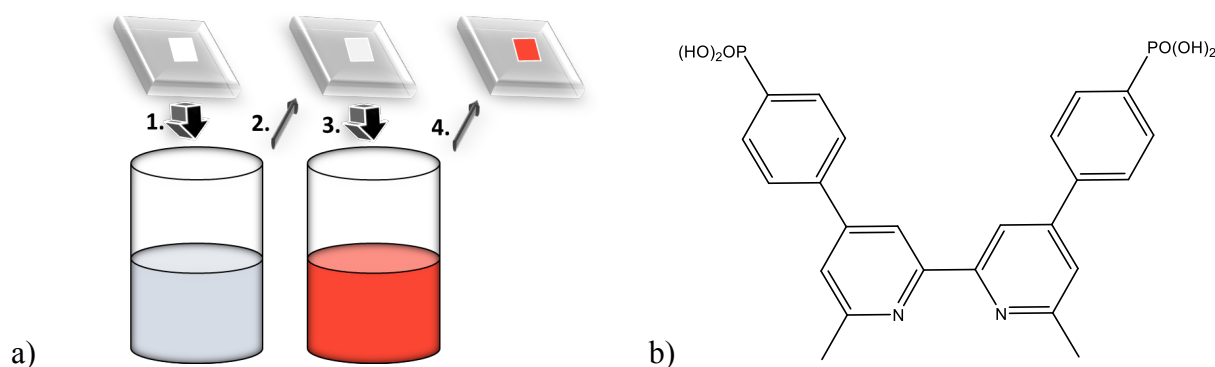


## Modifying spacers and anchoring groups for heteroleptic Cu(I) - 6,6'-dimethyl-2,2'-bipyridine based DSSCs

Y. Maximilian Klein

University of Basel

Heteroleptic  $[\text{Cu}(6,6'\text{-dimethyl-2,2'\text{-bipyridine}})_A(6,6'\text{-dimethyl-2,2'\text{-bipyridine}})_C]^+$  (A: anchoring ligand, C: capping ligand) complexes in which the bpy units are functionalized in the 4- and 4'-positions are known to be good light harvesting materials in dye-sensitized solar cells (DSSCs). When the formation of isolated heteroleptic  $[\text{Cu}(\text{bpy})_A(\text{bpy})_C]^+$  complexes is attempted, equilibration occurs giving mixtures of homo- and heteroleptic complexes; separation is very difficult. Therefore our group has developed a stepwise build-up of DSSCs (Figure 1a): a 'surface-as-ligand, surface-as-complex' approach.<sup>[1]</sup> For the first step a 6,6'-dimethyl-2,2'-bipyridine ligand, which is modified in the 4 and 4'-positions by a spacer bearing an anchoring group (e.g. 4-phenylphosphonic acid, Figure 1b) is bound to a  $\text{TiO}_2$  surface. Afterwards Cu(I) and a capping ligand are introduced by a ligand exchange reaction between the anchored  $\text{bpy}_A$  and a  $\text{bpy}_C$  of the homoleptic  $[\text{Cu}(\text{bpy})_C]_2^+$  complex. In previous work done by our group, much focus was put on the modification of the capping ligand to enhance photo to current efficiencies. The standard anchoring ligand with the best performance, which is currently used in our group is shown below. Changing the anchoring group from phosphonic acid to alternative groups<sup>[2]</sup>, as well as modifying the phenyl spacer to a thiophene spacer has been investigated<sup>[1]</sup> with a goal of enhancing solar cell performance for  $[\text{Cu}(\text{bpy})_2]^+$  complexes. Targets are to gain better affinity of the anchoring group to  $\text{TiO}_2$ , better electron transport through the spacer, less electron recombination between dye and electrolyte and an overall longer electron lifetime within the complex.



**Figure 1:** a) Preparation of heteroleptic  $[\text{Cu}(\text{bpy})_A(\text{bpy})_C]^+$  complexes on  $\text{TiO}_2$ : 1. One day treatment of the  $\text{TiO}_2$  coated glass plate in a solution of the anchoring ligand (1 mM in DMSO), 2. Cleaning, 3. Three days treatment of the modified  $\text{TiO}_2$  surface with a homoleptic  $[\text{Cu}(\text{bpy})_C]_2^+$  complex, 4. Clean and fabrication of the DSSC. b) Current standard anchoring ligand bearing two 4-phenylphosphonic acid groups in the 4- and 4'-positions of 6,6'-dimethyl-2,2'-bipyridine.

- [1] Y. M. Klein, M. Willgert, A. Prescimone, E. C. Constable, C. E. Housecroft, *Dalt. Trans.* **2016**, 45, 4659–4672.
- [2] Y. Baumgartner, Y. Maximilian Klein, E. C. Constable, C. E. Housecroft, M. Willgert, *submitted 2016*.