Inkjet Printing of Polarized Yeast Cells

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The motivation is to applying engineering knowledge to develop 3D bio-printing in inkjet printer (first stage--monolayer). To achieve the goal, there are three problems to solve. First, we have to figure out regulation of growth of target cells; inability to regulate the location and pattern of growing cells make us even unable to build 3D printer in the direct way. Second problem is how to protect of yeast cells from high temperature and viscous force when printing. The third issue is how to modify the inkjet printer especially the feeding system in order to implement printing on other materials rather than paper. We obtain inspiration that building a synthetic polarization system that include positive feedback and mutual inhibition can generate artificial PIP3 and CDC42 poles in living cells. We program the proper genetic circuit inside yeast that leading polarization in specific spatial position. After building the exogenous polarization network, we found we cannot solve the upward/downward overlap of yeast cells for any ways that difficult to form single layer. The attempt solution of protecting cells is adding certain amount of sugars and salts into medium; as a result viscosity of medium, heat conductivity will decrease meanwhile the medium would not be toxic to yeast cells. The experimental results demonstrate glucose tends to decrease the surface tension of cells that help distribute cells monolayer in the physical way. Result shows yeast cells are growing well in the pattern that being set before printing, meanwhile, they are distributed in monolayer at a high possibility just as expected, the validity supports polarization could be a feasible way in 3D tissue printing.