4. Contiguous Structures

If the separation distances and DMD pattern are appropriately chosen, then the individual structures can be made contiguous. Figure 5 shows an example of what can be achieved, where each adjacent image was formed using a single pulse. The dotted lines represent the approximate size and position of the individual objects (where each object is fabricated under identical conditions to that demonstrated in Fig. 3), in order to elucidate the level of overlap used during fabrication. The slight angular disparity of the text with respect to the stage movement axes is believed to be a slight misalignment of the vertical axis of the DMD surface. On the assumption that 1000 structures with width of 30μm can be fabricated in 1 second (based on the 1kHz laser repetition rate), a coverage of $1mm^2$ could, in theory, be fabricated within a timescale of order seconds. However, in practice, it is likely that the stage movement would not be accurate enough when operating at this required speed. In practice, for our experimental setup, coverage of $1mm^2$ can be achieved within two minutes, and hence $1cm^2$ on the order of a few hours. This, coupled with computer-automated control of the DMD pattern (i.e. changing the pattern between each laser pulse), will enable the fabrication of contiguous arbitrarily-shaped 2D devices.

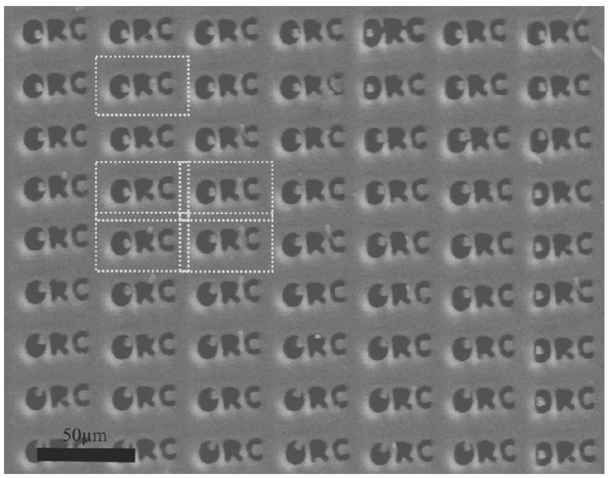

Fig. 5. Part of a large contiguous array of objects that have been fabricated using a single shot, stitched together by careful selection of object separation.

5. Conclusion

In conclusion, we have presented a single-pulse technique for the fabrication of complex structures via multiphoton polymerization. In addition, we have been able to fabricate these structures in arrays of ~mm size within a time scale of order minutes, representing orders of magnitude improvement in fabrication speed, with only a small loss in writing resolution. We anticipate that this work will lead to applications in fields including optics, nanomaterials and medical micro-devices. Future work will concentrate on the optimal resolution achievable when fabricating using single pulses.

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