oxidizing a portion of the exposed surface of the second device layer **516** to form an oxide layer.

One or more alignment holes **520** may be formed through the second insulating layer **518** and the second device layer **516** to expose the alignment targets **514** in the first device layer **502** as shown in FIG. **5**E. The alignment holes **520** roughly align with the alignment targets **514**. The alignment holes **520** may be made larger than the alignment targets **514**. With the alignment targets **514** exposed, it is possible to accurately align subsequent lithography and etch operations with respect to features in the first device layer **502**, such as the moveable element **510**, that are hidden by the second device layer **516**. Using the exposed alignment targets **514** as a guide, a first set of comb teeth **522** may be formed from the second device layer **516** as shown in FIG. **5**F. By way of example, the first set of comb teeth **522** may be formed by a deep reactive ion etch (DRIE) process. One or more alignment targets may also be formed through the second insulating layer **518** and second device layer **516** to facilitate alignment of features formed in subsequent layers.

In an alternative embodiment, two or more sets of comb teeth may be formed in the second device layer to provide a configuration such as that shown in FIG. **4**B. An insulating layer may be disposed between the first and second device layers to facilitate electrical isolation of the two sets of comb teeth.

A third device layer **526** may be attached to the second device layer **516** as shown in FIG. **5**G to facilitate formation of a third set of comb teeth. By way of example, and without loss of generality, the third device layer **526** may be part of a wafer **525** having the third device layer **526** disposed between third and fourth insulating layers **527**, **528**, e.g., a silicon layer disposed between two silicon oxide layers. The third device layer **526** may be attached to the second insulating layer **516**, e.g., by bonding the third insulating layer **527** to one or more remaining portions of the second insulating layer **518**.

An example of one of many possible ways for forming the second set of comb teeth from the third device layer is shown and described with respect to FIGS. **5**H–**5**K. As shown in FIG. **5**H, one or more alignment holes **530** may be formed through the fourth insulating layer **528**, third device layer **526** and third insulating layer **527** to expose the alignment targets **524** in the second device layer **516**. The alignment holes **530** may penetrate the insulating layer **527** to expose the alignment targets **524**. Subsequent processing operations may be aligned, e.g., with respect to first set of comb teeth **522** using the alignment targets **524**. In an optional operation, the handle substrate may be removed, e.g. by separating it from the first insulating layer **504** as shown in FIG. **5**I. A new handle substrate **532** may be attached to the first insulating layer **504**, as shown in FIG. **5**J, e.g., using a photoresist layer **534** disposed between the new handle substrate **532** and the first insulating layer **504**. The optional operations depicted in FIGS. **5**I–**5**J facilitate the release of the moveable element **510** as described below.

Using the exposed alignment targets **524** as a guide, a second set of one or more comb teeth **536** may be formed from the third device layer **516** as shown in FIG. **5**K. By way of example, the second set of comb teeth **536** may be formed by a DRIE process. By suitable offset of the second set of comb teeth **536** with respect to the first set of comb teeth **522** it is possible to configure one or more comb teeth in the first set to interdigitate with one or more comb teeth in the second set. To complete the device **500** the moveable element **510** may now be released, e.g., by removing the new handle substrate **532**, photoresist layer **534**, first insulating layer **504** and selected portions of the second and third insulating layers **518**, **527** as shown in FIG. **5**L. In a particular embodiment of the method, the release may be accomplished by removing the photoresist layer with a photoresist stripper and then a timed release of the comb teeth using hydrofluoric acid (HF).

Embodiments of the present invention thus provide the major benefit reduction of the footprint of microelectromechanical electrostatic combdrive devices such as micromirror devices. As described above, the footprint of a micromirror device can be reduced by extending one or more sets of comb teeth from a major surface of a moveable element in such a device. This allows for better system-level design in optical switches and provides the ability to pack the devices closer together. In the particular case of an optical switch, the ability to pack the micromirror devices closer facilitates the design and fabrication of higher density optical switches with increased port count while managing beam path lengths.

While the above is a complete description of the preferred embodiment of the present invention, it is possible to use various alternatives, modifications and equivalents. Therefore, the scope of the present invention should be determined not with reference to the above description but should, instead, be determined with reference to the appended claims, along with their full scope of equivalents. The appended claims are not to be interpreted as including means-plus-function limitations, unless such a limitation is explicitly recited in a given claim using the phrase "means for."

What is claimed is:

1. A method for making a microelectromechanical combdrive device, comprising:

forming a moveable element from a first device layer;

attaching a second device layer to the first device layer

forming a first set of comb teeth from the second device layer, wherein one or more comb teeth in the first set extend from a major surface of the moveable element;

attaching a third device layer to the second device layer; and

forming a second set of comb teeth from the third device layer,

wherein the first set of comb teeth are aligned to the moveable element by:

before attaching the second device layer to the first device layer, forming an alignment target in the first device layer, and

after attaching the second device layer to the first device layer and before forming the first set of comb teeth, forming an alignment hole in the second device layer, wherein the alignment hole is roughly aligned to the alignment target.

2. The method of claim **1** wherein one or more comb teeth in the second set are configured to interdigitate with one or more comb teeth in the first set.

3. The method of claim **1** wherein the first device layer is part of a wafer that includes a handle substrate.

4. The method of claim **3**, further comprising removing the handle substrate after attaching the third device layer to the second device layer.

5. The method of claim **3** wherein the handle substrate and first device layer are part of a silicon-on-insulator wafer.

6. The method of claim **5** wherein the silicon on insulator wafer includes an insulating layer disposed between the first device layer and the handle substrate.