Supporting Information

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I. General

Workup procedures were done in air. THF was freshly distilled from sodium benzophenone ketyl prior to use. Dichloromethane was distilled from P2O5 prior to use. Toluene was distilled from sodium prior to use. Liquid was transferred via a syringe or a cannula. Unless otherwise noted, all commercial materials were used without purification. TLC analysis of reaction mixtures was performed on Merck silica gel 60 F254 TLC plates. TLC plates were visualized by ultraviolet light and treated with acidic p-anisaldehyde stain followed by gentle heating. Flash column chromatography was carried out on Merck 60 silica gel (32-63 µm). 1H NMR and 13C NMR spectra were referenced to CDCl3. High Resolution Mass spectrum was measured at the Korea Basic Science Institute (Daegu). GaCl3, FeCl3, and InCl3 were purchased from Aldrich. [RuCl2(Benzylidene)(PCy3)2] was purchased from Strem Chem. Co. AuCl(PPh3)1 and Mn(CO)5Br2 were synthesized according to literature. Compounds 1a, 1h, 1j, 1l, 1m, 3m, and 1n were known compounds.

General procedure for GaCl3 catalzyed methathesis of allenyne.
To a flamed 10 ml Schlenk containing 5 ml toluene, 14 mg (10 mol%) of GaCl3 and 0.7 mmol of allenyne were added sequentially. After the reactant was disappeared, 1 ml diisopropylamine was added. After the reaction mixture was quenched, the solvent was removed under reduced pressure. A flash column chromatography gave the product.

II. Spectroscopic data for new compounds

\[ \text{3-(propa-1,2-dienyl)-1-tosyl-2,5-dihydro-}^{1}\text{H-pyrrole (2a)} \]

\begin{align*}
\text{\textsuperscript{1}H NMR (CDCl3, 300 MHz)} & : \delta 2.35 (s, 3 H), 4.02 (m, 2 H), 4.09 (m, 2 H), 4.93 (m, 2 H), 5.42 (s, 1 H), 5.80 (t, J = 6.6 Hz, 1 H), 7.25 (d, J = 8.0 Hz, 2 H), 7.65 (d, J = 8.2 Hz, 2 H) \text{ ppm;} \\
\text{\textsuperscript{13}C NMR (CDCl3, 75 MHz)} & : \delta 21.7, 54.8, 55.7, 78.5, 87.8, 120.7, 127.6, 130.0, 133.0, 134.2, 143.7, 211.0 \text{ ppm. Exact Mass for (C}_{14}\text{H}_{15}\text{N}_{1}\text{S}_{1}\text{O}_{2}, \text{ EI): (calc) 261.0823 (found) 261.0825}}
\end{align*}
\[ \begin{align*} \text{N-(buta-2,3-dienyl)-2,4,6-trimethyl-N-(prop-2-ynyl)benzenesulfonamide (1b)} \\
\text{\^H NMR (CDCl}_3, 300 MHz) \delta 2.19 (t, J = 2.2 Hz, 1 H), 2.29 (s, 3 H), 2.57 (s, 6 H), 3.85 (m, 2 H), 4.01(d, J = 2.2 Hz, 2 H), 4.77 (m, 2 H), 5.02 (m, 1 H), 6.92 (s, 2 H) ppm; \\
\text{\^{13}C NMR (CDCl}_3, 75 MHz) 21.0, 22.8, 34.6, 44.7, 73.0, 76.3, 85.3, 132.0, 132.3, 140.5, 142.8, 209.9 ppm. Exact Mass for (C}_{16}H_{19}N_{1}S_{1}O_{2}, EI): (calc) 289.1137, (found) 289.1133. \\
\end{align*} \]

\[ \begin{align*} \text{1-(mesitylsulfonyl)-3-(propa-1,2-dienyl)-2,5-dihydro-1H-pyrrole (2b)} \\
\text{\^H NMR (CDCl}_3, 300 MHz) \delta 2.29 (s, 3 H), 2.63 (s, 6 H), 4.09 (m, 2 H), 4.13 (m, 2 H), 4.98 (m, 1 H), 5.59 (s, 1 H), 5.94 (m, 1 H), 6.96 (s, 3 H) ppm; \text{\^{13}C NMR (CDCl}_3, 75 MHz) \delta 21.0, 22.9, 53.3, 54.3, 78.3, 87.8, 120.6, 131.9, 132.6, 132.7, 140.2, 142.5, 210.8 .Exact Mass for (C}_{16}H_{19}N_{1}S_{1}O_{2}, EI): (calc) 289.1137 (found) 289.1140 \\
\end{align*} \]

\[ \begin{align*} \text{(1c)} \\
\text{\^H NMR (CDCl}_3, 300 MHz) \delta 1.94 (t, J = 2.1Hz, 1 H), 2.93 (m, 2 H), 3.03 (d, J = 2.1 Hz, 2 H), 4.63 (m, 2 H), 5.26 (m, 1 H), 7.40 (m, 4 H), 7.53 (d, J = 7.4 Hz, 2 H), 7.95 (d, J = 8.0 Hz, 4 H) ppm; \text{\^{13}C NMR (CDCl}_3, 75 MHz) \delta 20.9, 29.2, 74.5, 75.7, 76.0, 83.0, 88.4, 128.7, 131.5, 135.0, 136.4, 210.5 ppm. Exact Mass for (C}_{20}H_{18}N_{1}S_{1}O_{2}, EI): (calc) 386.0647, (found) 386.0651. \\
\end{align*} \]
(2c)

$^1$H NMR (CDCl$_3$, 300 MHz) δ 3.36-3.37 (m, 4 H), 4.97 (m, 2 H), 5.11 (s, 1 H), 5.66 (m, 1 H), 7.54 (m, 4 H), 7.67 (m, 2 H), 7.97 (m, 4 H) ppm; $^{13}$C NMR (CDCl$_3$, 75 MHz) δ 39.1, 39.5, 78.4, 89.3, 91.3, 122.8, 129.0, 131.0, 134.9, 135.1, 137.0, 211.3 ppm. Exact Mass for (C$_{20}$H$_{18}$N$_1$S$_1$O$_2$, EI): (calc) 386.0647, (found) 386.0651.

N-(but-3-yn-2-yl)-N-(buta-2,3-dienyl)-4-methylbenzenesulfonamide (1d)

$^1$H NMR (CDCl$_3$, 300 MHz) δ 1.49 (d, $J = 7.1$ Hz, 3 H), 2.15 (d, $J = 2.2$ Hz, 1 H), 2.43 (s, 3 H), 3.78 (m, 1 H), 3.97 (m, 1 H), 4.78 (m, 2 H), 4.90 (dd, $J = 7.1, 2.2$ Hz, 1 H), 5.23 (m, 1 H), 7.30 (d, $J = 8.0$ Hz, 2 H), 7.74 (d, $J = 7.9$ Hz, 2 H) ppm; $^{13}$C NMR (CDCl$_3$, 75 MHz) δ 21.8, 22.8, 44.0, 46.0, 73.4, 76.6, 81.5, 89.3, 127.7, 129.7, 136.6, 143.6, 208.9 ppm. Exact Mass for (C$_{15}$H$_{16}$N$_1$S$_1$O$_2$, EI): (calc) 275.0980, (found) 275.0982.

2-methyl-3-(propa-1,2-dienyl)-1-tosyl-2,5-dihydro-1H-pyrrole (2d)

$^1$H NMR (CDCl$_3$, 300 MHz) δ 1.49 (d, $J = 6.6$ Hz, 3 H), 2.43 (s, 3 H), 4.07-4.24 (m, 2 H), 4.54 (m, 1 H), 5.01 (m, 2 H), 5.45 (s, 1 H), 5.82 (t, $J = 6.6$ Hz, 1 H), 7.31 (d, $J = 8.0$ Hz, 2 H), 7.72 (d, $J = 7.9$ Hz, 2 H) ppm; $^{13}$C NMR (CDCl$_3$, 75 MHz) δ 21.6, 22.3, 54.5, 63.0, 78.5, 87.4, 120.3, 127.3, 129.8, 135.1, 143.5, 210.7 ppm. Exact Mass for (C$_{15}$H$_{16}$N$_1$S$_1$O$_2$, EI): (calc) 275.0980, (found) 275.0982.
N-(buta-2,3-dienyl)-4-methyl-N-(pent-1-yn-3-yl)benzenesulfonamide (1e)

$^1$H NMR (CDCl$_3$, 300 MHz) $\delta$ 1.02 (t, $J = 7.7$ Hz, 3 H), 1.77 (qd, $J = 7.7$, 3.3 Hz, 2 H), 2.13 (d, $J = 2.2$ Hz, 1 H), 2.41 (s, 3 H), 3.72 (m, 1 H), 3.91 (m, 1 H), 4.60 (td, $J = 7.6$, 2.1 Hz, 1 H), 4.75 (m, 2 H), 5.26 (m, 1 H), 7.28 (d, $J = 7.9$ Hz, 2 H), 7.73 (d, $J = 7.9$ Hz, 2 H) ppm; $^{13}$C NMR (CDCl$_3$, 75 MHz) $\delta$ 10.7, 21.5, 29.0, 44.0, 52.2, 73.8, 76.2, 80.5, 88.9, 127.6, 129.4, 136.5, 143.4, 208.6 ppm. Exact Mass for (C$_{16}$H$_{19}$N$_1$S$_1$O$_2$, EI): (calc) 289.1137 (found) 289.1135

2-ethyl-3-(propa-1,2-dienyl)-1-tosyl-2,5-dihydro-$1^H$-pyrrole (2e)

$^1$H NMR (CDCl$_3$, 300 MHz) $\delta$ 0.82 (t, $J = 7.3$ Hz, 3 H), 1.78 (m, 1 H), 1.98 (m, 1 H), 2.40 (s, 3 H), 4.11 (m, 2 H), 4.62 (m, 1 H), 4.99 (m, 1 H), 5.48 (m, 1 H), 5.78 (m, 1 H), 7.27 (d, $J = 7.8$ Hz, 2 H), 7.69 (d, $J = 7.8$ Hz, 2 H) ppm; $^{13}$C NMR (CDCl$_3$, 75 MHz) $\delta$ 7.1, 21.5, 26.4, 55.4, 67.5, 78.2, 121.5, 127.2, 129.6, 135.1, 135.2, 143.3, 210.4 ppm. Exact Mass for (C$_{16}$H$_{19}$N$_1$S$_1$O$_2$, HRFAB): (calc) 290.1215 (found) 290.1213

N-(buta-2,3-dienyl)-4-methyl-N-(1-phenylprop-2-ynyl)benzenesulfonamide (1f)

$^1$H NMR (CDCl$_3$, 300 MHz) $\delta$ 2.40 (d, $J = 2.2$ Hz, 1 H), 2.44 (s, 3 H), 3.71-3.77 (m, 2 H), 4.42 (m, 1 H), 4.51 (m, 1 H), 4.77 (m, 1 H), 6.11 (d, $J = 2.2$ Hz, 1 H), 7.33 (m, 5 H), 7.60 (d, $J = 6.9$ Hz, 2 H), 7.79 (d, $J = 8.0$ Hz, 2 H) ppm; $^{13}$C NMR (CDCl$_3$, 75 MHz) $\delta$ 21.8, 44.6, 53.3, 76.0, 78.4, 87.9, 128.0, 128.3, 128.6, 128.63, 128.7, 129.7, 136.0, 136.6, 143.8 ppm. Exact Mass for (C$_{20}$H$_{19}$N$_1$S$_1$O$_2$, EI): (calc) 337.1137, (found)
2-phenyl-3-(propa-1,2-dienyl)-1-tosyl-2,5-dihydro-1H-pyrrole (2f)

$^1$H NMR (CDCl$_3$, 300 MHz) $\delta$ 2.42 (s, 3 H), 4.34 (m, 1 H), 4.45 (m, 1 H), 4.61 (m, 1 H), 4.91 (m, 1 H), 5.59 (m, 1 H), 5.76 (m, 1 H), 5.81 (m, 1 H), 7.17 (d, $J = 8.0$ Hz, 2 H), 7.27 (m, 5 H), 7.43 (d, $J = 8.0$ Hz, 2 H) ppm; $^{13}$C NMR (CDCl$_3$, 75 MHz) $\delta$ 21.6, 54.9, 55.0, 70.3, 78.7, 87.2, 121.2, 127.2, 127.9, 128.2, 128.5, 129.5, 136.2, 136.5, 140.0, 143.0, 211.4 ppm. Exact Mass for (C$_{20}$H$_{19}$N$_1$S$_1$O$_2$, EI): (calc) 337.1137, (found) 337.1137.

4-methyl-N-(penta-3,4-dien-2-yl)-N-(prop-2-ynyl)benzenesulfonamide (1g)

$^1$H NMR (CDCl$_3$, 300 MHz) $\delta$ 1.26 (d, $J = 6.2$ Hz, 3 H), 2.17 (t, $J = 2.2$ Hz, 1 H), 2.43 (s, 3 H), 3.96 (dd, $J = 18.5$, 2.2 Hz, 1 H), 4.15 (dd, $J = 18.5$, 2.2 Hz, 1 H), 4.60 (m, 1 H), 4.82 (m, 2 H), 5.07 (q, $J = 6.2$ Hz, 1 H), 7.29 (d, $J = 8.0$ Hz, 2 H), 7.80 (d, $J = 8.0$ Hz, 2 H) ppm; $^{13}$C NMR (CDCl$_3$, 75 MHz) $\delta$ 18.1, 21.7, 31.2, 32.0, 72.4, 78.1, 80.4, 91.8, 127.7, 129.7, 137.8, 143.6, 208.9 ppm. Exact Mass for (C$_{15}$H$_{17}$N$_1$S$_1$O$_2$, EI): (calc) 275.0980, (found) 275.0982.

2-methyl-4-(propa-1,2-dienyl)-1-tosyl-2,5-dihydro-1H-pyrrole (2g)

$^1$H NMR (CDCl$_3$, 300 MHz) $\delta$ 1.41 (d, $J = 6.2$ Hz, 3 H), 2.42 (s, 3 H), 4.04 (m, 1 H), 4.16 (m, 1 H), 4.51 (m, 1 H), 4.99 (m, 2 H), 5.40 (m, 1 H), 5.88 (m, 1 H), 7.31 (d, $J = 8.0$ Hz, 2 H), 7.72 (d, $J = 8.0$ Hz, 2 H) ppm; $^{13}$C NMR (CDCl$_3$, 75 MHz) $\delta$ 21.7, 23.0,
55.3, 64.0, 78.5, 87.7, 127.1, 127.6, 129.9, 131.4, 135.0, 143.6, 211.1 ppm. **Exact Mass**
for (C\textsubscript{15}H\textsubscript{17}N\textsubscript{1}S\textsubscript{1}O\textsubscript{2}, EI): (calc) 275.0980, (found) 275.0982.

\[ \text{N-(3-cyclobutylideneallyl)-4-methyl-N-(prop-2-ynyl)benzenesulfonamide (1i)} \]
\[ 1\text{H NMR (CDCl}_3, 300 \text{ MHz}) \delta 1.93 (m, 2 H), 2.01 (t, J = 2.2 Hz, 1 H), 2.42 (s, 3 H), 2.81-2.87 (m, 4 H), 3.81 (s, 1 H), 3.83 (s, 1 H), 4.13 (d, J = 2.2 Hz, 2 H), 4.98 (m, 1 H), 7.28 (d, J = 8.0 Hz, 2 H), 7.73 (d, J = 8.0 Hz, 2 H) ppm; 13C NMR (CDCl\textsubscript{3}, 75 MHz) \delta 17.5, 21.6, 29.6, 35.6, 46.6, 73.4, 77.2, 87.8, 103.0, 127.7, 129.5, 136.1, 143.5, 197.5 ppm. **Exact Mass** for (C\textsubscript{17}H\textsubscript{19}N\textsubscript{1}S\textsubscript{1}O\textsubscript{2}, EI): (calc) 301.1137 (found) 301.1134. \]

\[ \text{3-(2-cyclobutylidenevinyl)-1-tosyl-2,5-dihydro-1H-pyrrole (2i)} \]
\[ 1\text{H NMR (CDCl}_3, 300 \text{ MHz}) \delta 1.91 (m, 2 H), 2.33 (s, 3 H), 2.80 (m, 4 H), 4.03 (m, 2 H), 4.06 (m, 2 H), 5.38 (s, 1 H), 5.73 (m, 1 H), 7.23 (d, J = 8.0 Hz, 2 H), 7.64 (d, J = 8.0 Hz, 2 H) ppm; 13C NMR (CDCl\textsubscript{3}, 75 MHz) \delta 17.4, 21.5, 29.9, 54.8, 55.5, 89.8, 103.9, 120.1, 127.2, 129.7, 134.3, 135.2, 143.4, 197.4 ppm. **Exact Mass** for (C\textsubscript{17}H\textsubscript{19}N\textsubscript{1}S\textsubscript{1}O\textsubscript{2}, EI): (calc) 301.1137 (found) 301.1136. \]

\[ \text{(E)-3-(cyclohexenylmethylene)-4-methylene-1-tosylpyrrolidine (3j)} \]
\[ 1\text{H NMR (CDCl}_3, 300 \text{ MHz}) \delta 1.61(m, 4 H), 1.93(m, 2 H), 2.06(m, 2 H), 2.45(s, 3 H), 3.81(m, 2 H), 3.85(m, 2 H), 5.01(s, 1 H), 5.02(s, 1 H), 5.41-5.46(m, 2 H), 7.30(d, J = 8.0 Hz, 2 H), 7.67(d, J = 8.0 Hz, 2 H) ppm; 13C NMR (CDCl\textsubscript{3}, 75 MHz) \delta 21.7, 22.3, 23.1, 25.4, 28.9, 45.8, 49.8, 113.3, 120.7, 126.6, 128.1, 129.7, 133.9, 136.3, 136.5, 141.4, 143.7 ppm. **Exact Mass** for (C\textsubscript{19}H\textsubscript{23}N\textsubscript{1}S\textsubscript{1}O\textsubscript{2}, EI): (calc) 329.1449, (found) 329.1448. \]
N-(but-2-ynyl)-N-(buta-2,3-dienyl)-4-methylbenzenesulfonamide (1k)

$^1$H NMR (CDCl$_3$, 300 MHz) $\delta$ 1.49 (t, $J = 2.6$ Hz, 3 H), 2.35 (s, 3 H), 3.77 (m, 2 H), 4.00 (q, $J = 2.6$ Hz, 2 H), 4.69 (m, 2 H), 4.97 (m, 1 H), 7.21 (d, $J = 8.0$ Hz, 2 H), 7.65 (d, $J = 8.0$ Hz, 2 H) ppm; $^{13}$C NMR (CDCl$_3$, 75 MHz) $\delta$ 3.4, 21.7, 36.6, 45.7, 71.8, 81.7, 85.8, 128.0, 129.5, 136.4, 143.5, 209.9 ppm. Exact Mass for (C$_{15}$H$_{17}$N$_1$S$_1$O$_2$, EI): (calc) 275.0980, (found) 275.0981.

III. References for supporting information.